PB-229 422

CONFERENCE ON INTERSTATE POLLUTION OF NORTH FORK HOLSTON RIVER (2nd), HELD AT KINGSPORT, TENNESSEE, ON JUNE 19, 1962

Public Health Service
Washington, D. C.

19 June 1962

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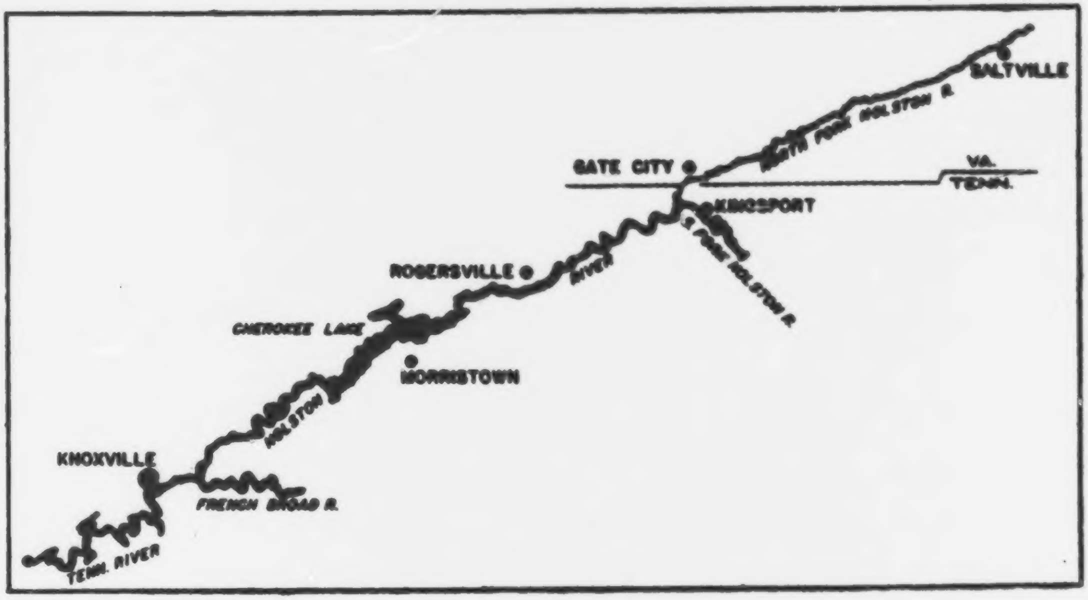
SECOND CONFERENCE

ON

INTERSTATE POLLUTION

OF

NORTH FORK HOLSTON RIVER


SALTVILLE
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KINGSPORT, TENNESSEE

JUNE 19, 1962

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CONFERENCE

In the matter of pollution of the interstate waters of North Fork of the Holston River, held at the Kingsport Utilities Conference Room, Kingsport, Tennessee, on

June 19, 1962

Chairman: Mr. Murray Stein
Chief, Enforcement Branch
Division of Water Supply and Pollution Control
U. S. Public Health Service
Washington, D. C.

Conferees: Mr. John R. Thoman
Regional Program Director, Region IV
Division of Water Supply and Pollution Control
U. S. Public Health Service
Atlanta, Georgia.

Dr. E. H. Hutcheson, Chairman of the
Tennessee Pollution Control Board,
Nashville, Tennessee.

Mr. Ross Walker, Chairman of the
State Water Control Board of Virginia,
Richmond, Virginia.

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TUESDAY MORNING SESSION

June 19, 1962

The Second Conference on Interstate Pollution of the North Fork of the Holston River convened in the Utilities Building, Kingsport, Tennessee, at nine o'clock, Mr. Murray Stein, Chairman of the Conference, presiding.

CHAIRMAN STEIN: The conference is open.

This conference in the matter of pollution of the interstate waters of the North Fork of the Holston River is being held under the provisions of the Federal Water Pollution Control Act. Under the provisions of that Act, the Secretary of the Department of Health, Education and Welfare is required to call a conference of this type when he is requested to do so by an official state water pollution control agency or when on the basis of surveys, reports, etcetera, he has reason to believe that pollution subject to abatement under the Federal Act is occurring.

In response to a request from the Tennessee Stream Pollution Control Board to the Surgeon General to hold a conference in this area on the North Fork of the Holston River, and on the basis of reports, surveys and studies, the Surgeon General called the First Session and the Secretary of the Department of Health, Education and Welfare has called the Second Session of the conference.

The purpose of these conferences is to bring together the State Water Pollution Control Agencies, the Department of Health, Education, and Welfare, and other interested parties to review the existing situation, the progress which has been made, and to lay a basis for future action by all parties concerned; and to give the states, localities and industries an opportunity to take any remedial action which may be indicated under state laws.

This conference mechanism is a time tested and proven technique. It is used by many states informally in the normal conduct of business in the field of water pollution control. As long ago as 1921 the United States Supreme Court in a famous interstate pollution case, New York against New Jersey, said, and I quote:

> "We cannot withhold the suggestion inspired by the consideration of this case that the grave problems of sewage disposal presented by the large and growing population living on the shores of New York Bay is one more likely to be wisely solved by cooperative study and by conference and mutual concession on the part of representatives of the states so vitally interested in it than by proceeding in any court, however constituted."

This, I think, is particularly applicable to this case. We have had one previous session of the conference and an informal meeting. I think we are dealing with some real live particularly delicate and complex problems, and it seems that the solution can be best met if we can meet it by a conference technique by all the parties understanding the problems of the other, and seeing whether we can come to some sort of mutual agreement.

Under Section 8 of the Federal Water Pollution Control Act, the official state water pollution control agencies of the states of Tennessee and Virginia have been notified of this Second Session of the conference. These agencies are represented here. Representatives of these agencies are privileged, of course, to bring whomever they wish to the conference and have them participate in it.

However, this should be made clear. Under the law this is a conference between the representatives of the official state water pollution control agencies and the Department of Health, Education and Welfare. The other participants in this conference are here at the invitation of the states.

The conferees representing the states and the Federal government have been designated and they are as follows:

Dr. R. H. Hutcheson, Chairman of the Tennessee Stream Pollution Control Board.

Mr. Ross Walker, Chairman of the State Water Control Board of Virginia.

Mr. John Thoman, Department of Health, Education and Welfare, of its regional office in Atlanta, Georgia.

My name is Murray Stein and I'm from Headquarters, Department of Health, Education, and Welfare, Washington, D. C.

Both the states and the federal government have responsibilities in dealing with interstate water pollution control problems. The Federal Water Pollution Control Act declares that the states have primary rights and responsibilities for taking action to abate and control interstate pollution. It has always been the policy of the Department of Health, Education, and Welfare to give full recognition to this traditional role of the states. The function of the Department is to encourage the states in this activity. However, the Department of Health, Education, and Welfare is charged by law with interstate pollution control problems. The Federal Water Pollution Control Act provides that pollution of interstate waters, whether the matter causing or contributing to such pollution is discharged into a tributary of such waters, which endangers the health and/or welfare of persons in a state other than that in which the discharge originates, shall be subject to abatement.

Under the Federal Act, the Secretary of the Department of Health, Education, and Welfare is required at the conclusion of the conference to prepare a summary of the conference, which will be sent to all conferees, the summary according to law must include the following:

1. Occurrence of pollution of interstate waters subject to abatement under the Act;

2. Adequacy of measures taken to an abatement of the pollution; and

3. Nature of delays, if any, being encountered in abating the pollution.

Where a situation does not lend itself to the covering of all these points at one session of the conference, we hold the conference in two and sometimes more sessions. The succeeding session, it was agreed on, is to be held on the call of the chairman and that call has been made. As has been pointed out, this is the second session of the conference.

Now, a word about the procedure governing the conduct of the conference. A recording and transcript will be made of the conference. A verbatim report of these proceedings is being made by Mrs. Ruth Greiner for the purpose of aiding us in preparing the summary, and also in providing a record of what is said and done here. We will make copies of the summary of the conference and a verbatim transcript of the conference available to the state representatives. All others who wish to get copies will receive them through their appropriate state agencies, which will distribute them. This is in accordance with the policy of the Department of Health, Education, and Welfare to keep the relationships of the people in the states with the official State Water Pollution Control Agencies rather than with the federal department.

All the conferees will be called upon to make statements. The conferees, in addition, may call upon participants they have invited to the conference to make statements. At the conclusion of such statements, the conferees will be given an opportunity to comment or ask questions, and at the conclusion of which the Department of Health, Education, and Welfare conferees may ask a question or two. In the past, this procedure has proven effective in developing a clear statement of the problem and reaching agreement on an equitable solution.

At the First Session of the conference held on September 28, 1960, it was agreed by the conferees that:

1. That the North Fork of the Holston River is an interstate water within the meaning of the Federal Water Pollution Control Act.

2. That pollution of interstate waters subject to abatement under the Federal Water Pollution Control Act is occurring in the North Fork of the Holston River; Allegations were noted which claimed that water quality of the North Fork of the Holston River was deteriorated so as to interfere with its use for: (a) Public water supplies; (b) Industrial Water supplies; (c) Recreation (including deficiency of fish, cloudy or milky appearance of the river, and muck on the bottom of the river and on the banks following high flows). Substantially all damage to recreation occurs in Virginia.

3. That discharges of industrial wastes from the Olin Mathieson Chemical Corporation at Saltville, Virginia are a major source of such pollution.

4. That measures presently used for the disposal of industrial wastes from the Olin Mathieson Chemical Corporation at Saltville, Virginia, are not adequate to secure abatement of pollution of the North Fork of the Holston River sufficient to meet desired water quality.

5. That with reference to the nature of delays, if any, being encountered in abating the pollution, Olin Mathieson management states there are no known corrective measures which are economically feasible so as to permit the operation of the Saltville Plant on a competitive basis.

6. That this is to be considered the first session of that conference and that the second session will be called by the Chairman not later than one year from the conclusion of this first session.

7. That the Olin Mathieson Chemical Corporation and the water pollution control authorities of Tennessee and Virginia will get together to discuss the problem. At the second session of the conference, the Olin Mathieson Chemical Corporation will be asked to give its prognosis of the possibility of meeting the problem.

8. That the National Technical Task Committee on Industrial Waste will be requested to arrange for a meeting of all soda-alkali producers in the country in order to stimulate and coordinate, on a nation-wide basis, research to provide effective treatment for wastes produced by this industry and to prepare a report.

On October 19, 1961 representatives of the two states, the Olin Mathieson Chemical Company and the federal government had a meeting to discuss interim progress since the first conference. At that meeting a report of the National Technical Task Committee was submitted and distributed, at least at that time or later, to all interested parties.

At this point, without objection, I would like to have this report inserted in the record as read because the official record does not contain the report of the National Technical Task Committee.

. . . The report of the National Technical Task Committee is as follows . . .

WASTE FROM SODA ASH MANUFACTURE

The ammonia-soda process for the manufacture of soda ash was first used commercially about 1870 and is still the most economical method of synthesizing the product. The inorganic chemistry involved is fairly complex, and as a classic, is discussed in most high school chemistry text books. A detailed discussion of all aspects of the process is presented in Manufacture of Soda by T. P. Hou (ACS Monograph #65). The process uses salt, limestone and fuel as raw materials with recycle streams of carbon dioxide and ammonia. Simplified and with all intermediate steps omitted, the reaction is: $2\ NaCl + CaCO_3 \rightarrow Na_2CO_3 + CaCl_2$. The reaction converts about 75 per cent of the sodium chloride to soda ash, and produces a waste liquor containing a mixture of sodium and calcium chlorides plus solids.

The solids are sand, coke ash, unreacted limestone, and precipitated water hardness constituents originally present in the process water. Standard practice in the industry is to remove solids by settling in large lagoons or waste lakes ("Ammonia - Soda Wastes and Their Disposal", U. T. Greene, 7th Industrial Waste Conference, Purdue University, 1952). The lakes are ordinarily on the order of hundreds of acres in size, with the most recent installation involving approximately 250 acres. This clarification is expensive and can be troublesome, especially if land availability at the plant site is limited. One requirement noted in the literature is 21 cubic feet of waste lake space required for solids per ton of soda ash produced.

The difficult waste problem in the manufacture of soda ash is the removal or disposal of sodium and calcium chlorides. For each ton of soda ash produced, there results wastes composed of approximately one ton of calcium chloride and one-half ton of sodium chloride (from unconverted sodium chloride). Typically these quantities are contained in 2,600 gallons of liquid. For example, each day that a plant produces 1,000 tons of soda ash, 1,500 tons of chloride salts dissolved in 2,600,000 gallons of liquid must be handled as wastes.

Since chlorides generally are soluble, do not break down, and are not subject to bacterial degradation, treatment possibilities are few. Part of the calcium chloride can be recovered from the waste by separation from the sodium chloride, although the recovery is generally not economic at the low levels dictated by the market. The current major use of calcium chloride is for ice and dust control on streets and roads. The Calcium Chloride Institute has for years been searching for additional uses. Some minor uses have been developed such as the use of calcium chloride in concrete, but no processes or industries requiring substantial amounts of calcium chloride have as yet been developed. If all calcium chloride were recovered from the waste, one medium size soda ash plant could supply the entire U. S. market.

Some work has been done on separation with ionic membranes, but little hope for a complete solution to the problem is seen for this method, since it results in chloride concentration only instead of complete separation. In addition, subsurface disposal has been considered, but the large volumes involved precludes use of this method.

A different approach to the manufacture of soda ash without this waste problem would be to change the process so as to eliminate the by-product calcium and sodium chlorides characteristic of the ammonia-soda process. Other methods of producing sodium carbonate have been investigated, including the Hargraves - Bird Cell and the carbonation of sodium hydroxide produced electrolytically. The Hargraves - Bird Cell converts brine and carbon dioxide as raw materials into chlorine and a mixture of unconverted brine and soda ash which are separated by crystallization. The Hargraves - Bird Cell was never used extensively for the manufacturing of soda ash and is not considered economical at today's costs.

The feasibility of the carbonation of electrolytic caustic depends on the value assigned to the caustic. If the electrolytic caustic is taken at no value, this process might be feasible. Since caustic soda currently sells at $54 per ton, the price of soda ash made by this process would have a minimum cost of $41 per ton based on equivalent alkalinity, not considering the necessary costs involved in the production. As a comparison, soda ash made by the ammonia-soda process is priced at $31.50 per ton. Further, electrolytic caustic is a coproduct resulting from cells operated primarily to produce chlorine at production levels dictated by chlorine sales; manufacture of electrolytic caustic is not and cannot be based on the requirements for carbonation to soda ash. From these considerations, it is apparent that carbonation of caustic cannot generally replace the ammonia-soda process on an economic basis.

Another technique for avoiding discharge of chlorides from soda ash manufacturing wastes is to produce ammonium chloride, which in Japan is used as a fertilizer. However, in this country, ammonium chloride has not been used as a fertilizer because of soil characteristics, and it is doubtful such use would ever be possible.

Solutions to the problem which have been discussed thus far are treatment of the chloride waste and modifications of the ammonia-soda process to avoid such wastes. The present method of handling such wastes is one practiced by all soda ash producers in this country -- discharge to surface waters. Historically, our first plants were constructed during the period 1884-1912 on inland waters close to both raw materials and markets. The three most recently constructed soda ash plants (1934-1935) were established on or near tidewaters where effects of chloride wastes would be negligible. No new plants have been constructed in the U. S. since 1935. (See attached map and table.) Industry representatives all agree that U. S. ammonia-soda ash expansion, if any, should be on the coastal areas.

All members of the industry agree that discharge of soda ash wastes to salt or brackish water is most certainly the best method of dealing with this problem. However, discharge of soda ash wastes to fresh water is not a major pollution problem where ample dilution water is available. Where plants have been located on the headwaters of a river system, leading to some deterioration of water quality, detention ponds and regulated discharge to correspond with watershed runoff patterns have minimized degradation of the streams. Another method of alleviating this pollution problem is to augment the flow of the receiving stream. One plant, for example, has dug and operated wells for this very purpose. However, the total amount of chloride waste reaching the stream has not been reduced by regulated discharge.

Several years ago ORSANCO published a study of soda ash waste discharge ("Brine Contamination of the Muskingum River", ORSANCO, 1951). With this background and with the cooperation of the advisory Chemical Industry Committee composed or representatives of leading chemical producers, a chloride control measure was formulated in 1958 after thorough study and consideration of all factors involved. (Addenda 2). The Control measure requires impoundment of wastes containing significant chloride loads with regulated discharge under the supervision of the appropriate state water pollution agency. This procedure recognizes the lack of treatment methods for chloride wastes in utilizing dilution as the only practical course of action available.

A safeguard, but not a remedial measure, is the warning system established on the Ohio River for analysis and transfer of chloride content data to state and interstate water pollution control agencies. Again, this helps to reduce the consequences of accidental spills, but does not actually abate pollution. The result has been an improvement in water quality management.

Soda ash is a basic chemical and its per capita use is a good index of a nation's industrial progress. Because of the high investment necessary for an ammonia-soda plant and the accompanying high fixed costs, soda ash is a tonnage chemical and cannot be economically manufactured in small quantities. The generally accepted minimum economical plant size in the United States is about 500 tons per day capacity. The investment will range from $20,000 to $40,000 per daily ton of capacity.

The industry generally is in a position of overcapacity, precluding a much needed price increase. Competition has increased in recent years from sources such as trona and some excess caustic soda production which can be substituted for some uses of soda ash. Trona (naturally occurring soda alkali) is mined in the western areas of the country, refined, and can now be shipped as far east as Pittsburgh at competitive prices.

It is unlikely that a new ammonia-soda plant can be built in the United States at prevailing costs and prices. If such a plant could be built, it would probably be located near the seacoast for disposal of wastes and close to deposits of salt and limestone for low-cost raw material. Most of the present installations in this country were built many years ago when stream pollution was not a factor in location.

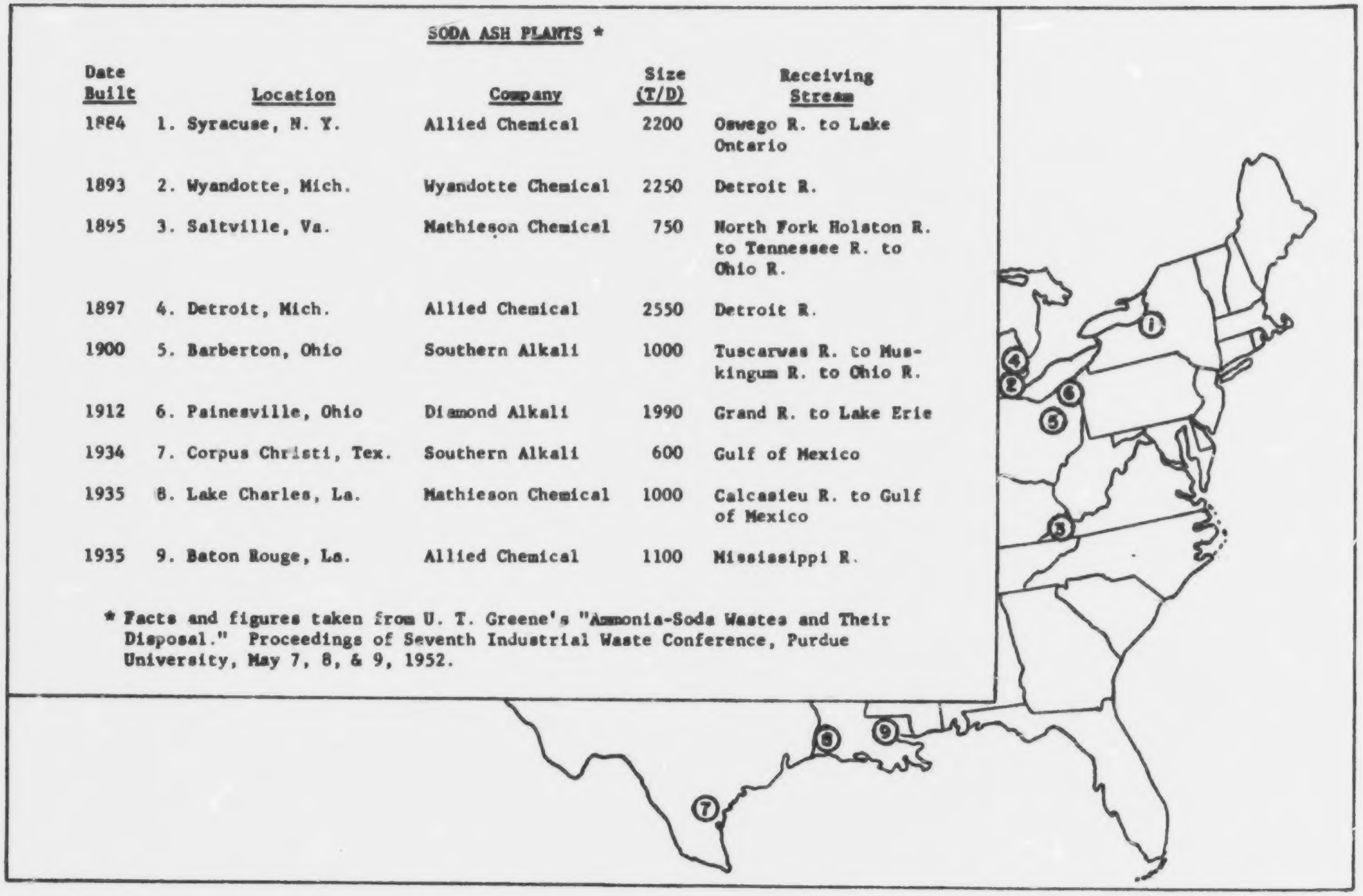
In the one hundred or so years since the ammonia-soda process was introduced, very substantial amounts of money have been spent on process research by various producers throughout the world. The considerable amount of research done has resulted in equipment improvements only; no change has ever been made in the basic chemical reactions involved in the process. It is, therefore, unlikely that any avenue not already investigated will be uncovered by additional research pointed towards the discovery of a new process for making soda ash. This has been the goal of many alkali research people for years, and to date -- after the expenditure of tremendous amounts of research money -- there has been no success in developing an alternate process usable in the United States.

CONCLUSION

It is evident from the foregoing presentation that there is no ready alternative to present methods of disposal of soda-alkali industry wastes. Considering the industry as a whole, however, there is no reason to believe that existing disposal methods pose a serious pollution problem. Where these wastes are necessarily discharged to smaller water systems, ponding and controlled discharge have proven to be effective control measures satisfactory to the state authorities involved. During the industry's history, extensive research has failed to find an alternate practicable method of waste disposal. At present, industry is unable to recommend or envision any research program offering any hope of success. This does not eliminate the possibility, however, that future scientific developments in wastes disposal or related fields may provide a breakthrough leading to improved methods of handling the industry's wastes. We believe the industry's future role and responsibility will lie in maintaining a vigilant, current review of such developments with evaluation of their practical application where it appears warranted.

October 1961 Submitted by:

J. F. Hunter	Wyandotte Chemicals Corporation
M. W. Jones	Pittsburgh Plate Glass Company Chemical Division
W. L. Leucht	Allied Chemical Corporation Solvay Process Division
L. W. Roznoy	Olin Mathieson Corporation
W. R. Taylor (Chairman)	Diamond Alkali Company



SODA ASH PLANTS *

Date Built	Location	Company	Size (T/D)	Receiving Stream
1884	1. Syracuse, N. Y.	Allied Chemical	2200	Oswego R. to Lake Ontario
1893	2. Wyandotte, Mich.	Wyandotte Chemical	2250	Detroit R.
1895	3. Saltville, Va.	Mathieson Chemical	750	North Fork Holston R. to Tennessee R. to Ohio R.
1897	4. Detroit, Mich.	Allied Chemical	2550	Detroit R.
1900	5. Barberton, Ohio	Southern Alkali	1000	Tuscarwas R. to Muskingum R. to Ohio R.
1912	6. Painesville, Ohio	Diamond Alkali	1990	Grand R. to Lake Erie
1934	7. Corpus Christi, Tex.	Southern Alkali	600	Gulf of Mexico
1935	8. Lake Charles, La.	Mathieson Chemical	1000	Calcasieu R. to Gulf of Mexico
1935	9. Baton Rouge, La.	Allied Chemical	1100	Mississippi R.

* Facts and figures taken from U. T. Greene's "Ammonia-Soda Wastes and Their Disposal." Proceedings of Seventh Industrial Waste Conference, Purdue University, May 7, 8, & 9, 1952.

Addenda 2
Resolution No. 17-58
Chloride-control measure
Adopted September 12, 1958

WHEREAS: By resolution adopted at a regular meeting held on the 6th day of April, 1955, the Ohio River Valley Water Sanitation Commission promulgated a statement of policy and procedures for the control of industrial waste discharges into waters included within its jurisdiction by the terms and provisions of the Ohio River Valley Water Sanitation Company; and

WHEREAS: Uncontrolled as well as improperly controlled discharges of wastes containing chloride may cause degradation of the quality of the waters of the Ohio River Valley Water Sanitation District, contrary to the language and intent of the Ohio River Valley Water Sanitation Compact;

NOW, THEREFORE: In furtherance of the statement of policy and procedures promulgated as above set forth and for the purpose of contributing to the achievement of the objective specified in Article I of the Ohio River Valley Water Sanitation Compact by safeguarding the quality of the waters of the Ohio River Valley Water Sanitation District and of securing maximum utilization of the capacity of those waters for assimilating chloride waste discharges;

BE IT RESOLVED: That the following measures are hereby adopted by the Commission to be followed by the signatory states for the joint cooperative control of chloride discharges:

1. Existing and future discharges of wastes containing significant chloride loads into the waters of the Ohio River Valley Water Sanitation District shall be subject to control by impoundment or by such other methods as may be acceptable to the water pollution-control agency of the state in which the discharge originates, so as to insure that the amount thereof shall conform to a discharge schedule to be formulated, as hereinafter provided, for the purpose of maintaining an acceptable proportion between the amount of such chloride-containing wastes and the volume of flow in the stream into which it is discharged;

2. In order to insure appropriate ratios between chloride-waste discharges and volume of stream flows, all impoundment basins and other control methods shall be operated in accordance with schedules to be formulated by the water pollution-control agency of the state in which

the discharge originates in consultation with the Ohio River Valley Water Sanitation Commission.

* * *

CHAIRMAN STEIN: In addition to that, Dr. Z. G. Deutsch prepared a report on "Amelioration of River Pollution by Alkali Factories". This report was revised on October 24, 1961, and also distributed to the interested parties, and we ask that it be inserted in the record as read. I think most of the people are familiar with that, and we can direct our attention to any material coming up in that report.

. . . The report of Dr. Z. G. Deutsch is as follows . . .

AMELIORATION OF RIVER POLLUTION BY ALKALI FACTORIES

The problem of waste disposal in the alkali industry has become increasingly difficult, first because of increased production at each factory as population, industrialization and living standards have built up, and secondly, because of increased urbanization of the surroundings of alkali factories.

Alkali manufacture can be regarded as that industry which mines common salt to upgrade it for chemical uses. The first step in upgrading is merely that of making pure salt (or brine) from the impure mineral, although that step is also practiced by the salt industry on a scale about equal to a third of that of the alkali industry. The second upgrading step is the conversion of the pure salt to more chemically active sodium compounds.

For over 160 years, chemical industry has converted common salt to soda ash, (sodium carbonate, Na_2CO_3) which has been used principally in the making of glass and soap, and in such operations as degreasing of wool, and for chemical "sweetening", i. e. neutralization of excess or unwanted acidity as in petroleum refining, ore beneficiation, and metallurgy. The next stage of chemical upgrading has been the conversion of sodium carbonate to the more reactive caustic soda (sodium hydroxide, NaOH). More recently both sodium carbonate and hydroxide, collectively referred to as Na_2O, have been used in the manufacture of a host of bulk and fine chemicals, fertilizers and plastics; these all becoming more and more diversified and sophisticated. The sodium alkalis consumed in the U. S. A. now amount to about 130 pounds per capita per year. The annual value of sodium alkalis and chlorine together approaches $900 millions.

Causticizing of soda ash was done originally through liming of a sodium carbonate solution; throwing away the resulting calcium carbonate sludge, but more recently, reusing the sludge by recycling through a "wet" kiln. Beginning in the late 19th century, salt was converted directly to caustic soda with co-product elemental chlorine by the electrolytic process.

The earliest method of chemical conversion of salt was known as the LeBlanc process, now obsolete, and never used in the U. S. A. During the last part of the 19th century, the LeBlanc process was gradually replaced by the Solvay process which began operations in the U. S. A. about 1885 and still today converts well over half of the total salt (domestic and industrial) in this country, and a bigger fraction elsewhere. The electrolytic process, which was born late in the 19th century, is growing much more rapidly than is the Solvay process and most forecasters of today predict that the days of the Solvay process are numbered because of the combined threat of the electrolytic process, and a greater exploitation of mineral deposits of natural alkali. In the U. S. A. the known deposits of natural alkali are exploited in the states of California and Wyoming, which together as yet account for well under 10 per cent of the total alkali furnished to industry. The Wyoming operations although started much later than the California ones, are growing more rapidly. Of these three currently used alkali production methods (Solvay, Electrolytic, and Natural) the waste disposal aspects of only the Solvay and Electrolytic methods are herein discussed.

Both the Solvay and Electrolytic processes (as well we the salt industry), in the purification of salt from the halite mineral, dispose of some 3 to 10 per cent of their mined salt with the underflow of the settlers where impurities (mostly calcium and magnesium hardness) are removed. The calcium and magnesium contents of mineral salt vary over a wide range, especially the magnesium. The order of magnitude of the average might be taken as 100 pounds of hardness as $CaCO_3$ per ton of NaCl fed to the factory.

For each 1,000 tons of pure salt contained in the mineral to be converted, the alkali industry potentially puts on the market some 900 tons of alkali (expressed as soda ash) and also some 600 tons of chlorine (expressed as the unpackaged element). The ratio of 1 1/2 tons of alkali to one ton of chlorine is the way nature put salt into the ground and the two are so intimately compounded that one cannot be mined without the other. Hence, in considering the alkali industry (both Solvay and Electrolytic) as miner of crude salt and its refinement to both alkali (Na_2O) and chlorine (Cl_2) for all of industry, it is seen that alkali must not only dispose of the "slag" in its mineral, but also whichever of the two constituents is in excess of sales demand. Man's demand for the two has never been in balance. In the U. S. A. the average demands have been (approximately):

	Total Alkali as Na_2CO_3 1000 T/yr	Chlorine 1000 T/yr	Ratio Ash/Cl_2
1900	493	6	82
1910	875	20	44
1920	1,450	70	21
1930	2,520	200	12.6
1940	3,970	670	6.0
1950	6,680	2,000	3.4
1960	11,630	4,600	2.54

This recent U. S. A. ratio of 2.5 is lower than in any other region in the world. Elsewhere in the world, especially in countries of recent industrialization, where there has never been a Solvay operation, electrolytic factories could afford to "dump" chlorine to try to minimize their alkali imports.

The recent growth in the U. S. A. of the demand for chlorine has been so rapid that by 1960 the electro-process had nearly eliminated the conversion of soda ash to caustic soda by the lime process. Elemental chlorine is too reactive and poisonous to be wasted or disposed of (without liming); consequently, the market balance of its two products governs electrolytic production rate. Small quantities of each of the two co-products can, of course, be stock-piled and reclaimed to take care of minor market variations.

In the ammonia soda (or Solvay) process for making sodium carbonate from salt, ammonia is used as a reagent and is kept in full recycle by disassociation of ammonium chloride with lime. This produces calcium chloride; roughly one ton for one ton of soda ash. In the process, also, the raw material, salt, is not completely converted so that the waste from a Solvay type alkali factory consists of a dilute solution containing about one-fourth of the 1.5 to 1.7 tons of salt "mined" per ton of soda ash, in addition to the calcium chloride. The unclarified waste solution also carries solid particles consisting of the impurities found in the salt itself, in the limestone burnt to lime for ammonia recovery, and in the ashes of some of the fuels used. This solution is usually clarified in large diked areas and the settled solids are used to build up the dikes.

The electrolytic process, on the other hand, uses no lime (except to remove magnesium from brine) so that the principal waste from an electrolytic factory is that resulting from purification of the original crude salt. That is, the calcium and magnesium contents of the crude salt must be disposed of and these carry along, of necessity, a small fraction of the raw salt. Hence, a large electrolytic factory, working with low grade salt, could conceivably contaminate a stream more than a very small ammonia-soda factory, using high quality salt and selling a large part of its ammonium chloride. No such situation exists, or even threatens, but it is a theoretical possibility which must be kept in mind when considering items 1 and 3 on the next page. All U. S. A. ammonia-soda factories now have adjacent electrolytic plants.

In the early days of the alkali industry, soda ash factories were placed where mineral salt had a good grade of limestone were in favorably juxtaposition with a ready market for alkali. Several factories were therefore built along small rivers, which, with the passage of time, have limited further expansion of these factories. More recently new alkali factories have tended to be built on very large rivers where the contamination is inconsequential, or on seacoasts where the waste is disposed of directly to the tide movements of the ocean, without ill effect on anything.

What are the possible ways of minimizing alkali factory wastes? In the following, the potentialities, the limitations, and the degree of development (or lack of it) of most methods for ameliorating the pollution of stream by Solvay alkali factory waste, are briefly discussed:

1. Conversion to electrolytic process.
2. Improved and/or more extensive impounding.
3. Sale of NH_4Cl.
4. Sale of $CaCl_2$ (and salt).
5. Underground disposal via wells.
6. Improved salt utilization efficiency.
7. Other (than CaO) methods of NH_3 regeneration,
   (a) Manganese chloride method
   (b) Caustic cell liquor plus flue gas
8. Pipe the clarified solution downstream.

The above eight are listed in the approximate order of their promise of improvement -- all things considered. Possibly a method as yet not invented may be just beyond the near industrial horizon, but it is impossible to assess the length of time before it might be available, or how commercially practical such a method may be.

1. Conversion to the Electrolytic Alkali Method

It is obvious from the table given above that this conversion is already well advanced for the alkali industry as a whole. It is equally obvious that within another two to three decades, the hardness aspect of the disposal problem will be nearly eliminated, unless there is some radical change in the 60 year trends of use. What is not so obvious is that this method promises the most reduction in pollution and probably the least increased cost of alkali to the public and to industry, if allowed to proceed at its normal economic pace rather than to force the conversion in a particular alkali factory. If the conversion is forced beyond the speed that the chlorine market gains on the alkali market, the disposal problem shifts from a calcium or a chloride contamination to a sodium contamination.

With the ammonia soda process (from already purified salt and brine), a ton of soda ash potentially puts into the adjacent water courses approximately one ton of calcium chloride; approximately one-half ton of sodium chloride, plus minor amounts of "dirt" (fuel ash, quarry impurities, etcetera). By comparison, the electrolytic process, again from purified salt, or brine, puts practically no calcium into adjacent water courses and only minor amounts of sodium and chloride resulting from intermittent and somewhat rare purges of residual salt impurities. However, the electrolytic process requires at least double the investment per unit of alkali as compared to the Solvay process, but the higher investment produces more than twice the value of products (caustic soda plus chlorine). The problem is, of course, that the demand for the two co-products must remain in balance, as it is almost never possible to remain in business when "dumping" (either physically or at distress prices) either of the two co-products. Further, the freight hauls, interchanges, stockings and reclaimings, cut deeply into potential profits unless both products can be sold "in balance".

Many of the users of alkali must have (or prefer) the carbonate rather than the hydroxide (that is, soda ash, rather than caustic soda). Caustic soda can be converted back to soda ash, using flue gases from boilers or other source of CO_2 rather than kiln gases from lime burning as used in the Solvay process. According to historical pricing and the familiar conversion of caustic soda to soda ash, such carbonation is "down grading". A readjustment of alkali and chlorine prices seems imminent; chlorine and ash to increase and caustic to reduce to where ash users can afford the cost of carbonation. The carbonation of caustic soda is a very young process, industrially speaking, and is practiced only on the coast of the Gulf of Mexico on a small scale at the present time, but it can be expected to develop its technology as well as its volume. However, quite a number of alkali users, especially the metallurgical industries, who had originally used soda ash, have begun to buy caustic soda at a negotiated price approaching soda ash equivalence, so the handwriting is already on the wall. It thus is apparent that the most serious waste disposal problem for the Solvay type alkali factory is well on the way toward solving itself, but only when one considers the industry overall. For any particular location, the balance of market for chlorine and alkali may lag way behind the general trend. But with a substantial electrolytic operation growing rapidly at each and every U. S. A. ammonia-soda location (and in many other places as well) the time is not far distant when the hardness contamination and chloride contamination will have been greatly ameliorated (although never entirely eliminated because of brine purification).

2. More Extensive and Precisely Controlled Waste Impounding

The flow of all rivers is quite variable from season to season as well as from year to year. Only into the largest rivers can the hardness and chloride be disposed hour by hour, the year round, without significant pollution. Based on the average production of alkali, and the average river flow, some impounding is usually necessary to avoid intolerable contamination during low river flows. Impounding has limitations, of course, along small and highly variable streams, especially those where there may be several successive years of drought. Under such unfavorable conditions, very extensive and expensive dams and dikes, as well as large land areas are needed, sometimes large enough to limit the output of the product at otherwise profitable locations. These impounding works are generally unsightly (even dangerous) and the public often considers them a nuisance.

The biggest contaminant (although perhaps not the most objectionable) is the chloride ion. The following table gives the approximate flow required for three capacities of soda ash factories to keep the chloride contamination at levels known to be suitable for various kinds of irrigated crops.

Tons of Alkali/day (Made by Solvay method) as Na_2CO_3	Steady Flow Cu. ft./per second in Disposal Stream		
	Sensitive Crops	Most Crops	Chloride Resistant Crops
300	700	350	230
600	1,400	700	460
1,000	2,400	1,200	800

Note that the tabular values refer to steady flows and cannot be referred directly to annual mean flows. The regulation of impounding basin overflow must take cognizance of a number of factors, including:

1. Variation in river flow
2. Salinity of impounding basin surface (rain water floats on top)
3. Irrigation season
4. Variations in factory production rate.
5. Potential dilutions immediately downstream

That is, it is usually more practical to stop all impounding basin release during lowest river flows and during irrigating seasons and thus depend on somewhat higher discharges during highest river flows and non-irrigating periods. The contaminants (sodium, chlorine, and hardness) do no significant harm if always held below some level and can do much harm if greatly exceeding that level even for short times. Hence adequate impounding can completely solve the problem where the river is small, but occasionally has a sufficiently high flow.

Almost invariably where streams are small (among the hills of stream headwaters) the terrain is such as to make impounding quite expensive, not only per unit of reservoir, but also because hazards from seepage and the frequency of harassing public complaints are burdensome. Nevertheless, it seems that somewhat expanded impounding facilities and the instrumentation for more precise control on time to release and of release-rate, can ameliorate contamination. At some plants such amelioration can be substantial.

3. Sale of Ammonium Chloride

The ammonium chloride which is decomposed by lime for recycle of ammonia in the Solvay process alkali factory is a product which, under certain circumstances, can be sold profitably. Unfortunately, those circumstances obtain at very few places. First of all, there must be an adjacent profitable ammonia synthesis operation. Secondly, and this is much more restricting, the only high volume market for ammonium chloride is in the fertilizer field and the farmers' acceptance of this salt as a fertilizer proceeds very slowly in spite of its high nitrogen content per unit of weight shipped. Certain crops require nitrogen at a rate so high that the associated chloride ion acts as a rather serious growth inhibitor. Nevertheless, since the end of World War II, at foreign alkali plant locations, where copious natural gas is conducive to low cost ammonia synthesis, this operation is succeeding and it holds profit potentiality on the basis of recently developed technologies, although considerably less (on an absolute waste disposal basis) than does the inevitable conversion to the electrolytic process. The NH_4Cl process deserves especially favorable consideration at those alkali sites where the prevailing climate and crops lend themselves to NH_4Cl fertilization. Also where waste disposal trouble is inhibiting the profit potentialities of expanded operations. Missionary work by fertilizer scientists and others, right down to the "county agents" can be foreseen as the biggest factor in the possibilities of this method.

4. Sale of Calcium Chloride

The process for producing salable concentrations and quality of calcium chloride from the ammonia soda plant distiller waste is quite well developed and has been practiced at enough actual factories over a long enough time that the know-how is quite well distributed and near its ultimate of technical perfection. Unfortunately, in spite of herculean sales efforts, the total amount of calcium chloride which can be marketed even at very marginal profits represents well below 1/20 of that contained in the entire alkali industry waste volume. Furthermore, even when marketed and used locally (and it must be marketed locally because it cannot carry a high freight rate) practically all of it eventually finds its way into the local water courses just as surely as if it had never been separated from the alkali factory distiller waste stream. The indication, today, is that ammonium chloride holds more promise than does calcium chloride.

5. Underground Brine Disposal Wells

In certain oil fields, a brine is often part of the flow from petroleum wells and in certain arid places where agriculture is important, these brines are forced back down into the cavities from which they came or else into strata which carry them out to the ocean without affecting the salinity of any surface of well waters.

Possibly this same method could be applied to a part of the waste of a Solvay type alkali factory. To the best of the writer's knowledge, it is not practiced at an alkali factory anywhere in the world, hence the method can only be assessed on theoretical analysis. The potentialities have received a minor amount of study which has shown the idea to have poor promise. The waste contains enough free lime and magnesia, even though these are very minor concentrations, to threaten the continuing porosity in the stratum to be used. Again, although many water bearing strata have good tight "ceilings" locally, complete absence of geological faults can never be assured. At most potential alkali plant sites where such a process might be applicable, the distance to the sea is quite considerable, and with irrigation wells, piercing to ever deeper aquifers, there would be great difficulty in making sure that the disposal stratum would nowhere contaminate usable fresh-water-bearing strata. Hence, this idea seems to have very little promise except at uniquely favorable locations.

6. Improved Salt Utilization Efficiency

Reduced consumption of salt per unit of Na_2O would only reduce chloride contamination and would have substantially no effect on hardness contamination. As is reasonably well known, the ammonia soda process is rather inefficient in its salt utilization. This efficiency varies in actual routine practice between about 66 per cent and 75 per cent. Numerous studies have been made on methods for improving this efficiency and it is now well known that any substantial or significant improvement would require added new investment which the profit potential of the process could seldom, if ever, justify. However, minor improvement such as, say, from 68 per cent to 75 per cent, is purely a matter of good control and rigorous attention to day by day "chemical housekeeping". Like good control of operation of an impounding reservoir, improved salt utilization might have minor ameliorating effects at some specific operations.

7. Other Processes for Ammonia Regeneration

A number of proposals have been made whereby the ammonium chloride can be decomposed, to recycle the ammonia, without producing calcium chloride, but instead producing elemental chlorine or something equally salable. Some of these proposals have received a reasonable amount of research investigation. To the best of the writer's knowledge none of these shows any promise with economic conditions in chemical industry as they are today. Present trends of change in chemical economics do not point in a direction that appears to make any of these processes profitable "tomorrow". However, to extend the life of the sites which are favorable in every aspect except that of waste disposal, some of these processes may offer the needed bridging over of time until the electrolytic process becomes more dominant.

For example, the ammonium chloride can be converted to manganese chloride which can in turn be oxidized to release chlorine. These are rather high temperature reactions requiring high investments for manganese regeneration and the corrosiveness of the several equipment atmospheres seems to entail high maintenance costs as well as high capital costs.

Another example, requiring much less development, simpler operations and cheaper equipment, would be the use of dilute caustic from electrolytic cells (instead of lime) for the regeneration of NH_4Cl. This can readily be done with only minor changes up to about 15 or 20 per cent of a plant's capacity and would reduce contamination by hardness to that extent. Conceivably, the NH_3 stripped solution could then be used for fresh brine making, thus reducing sodium and chloride contamination as well. Beyond the 15 to 20 per cent, flue gas (9-13% CO_2 vs 40-42% now obtained from kilns) would have to be used which would require much larger investment and power consumption. Under present "economics" the alkali value of the cell liquor is of higher order than the incremental lime and salt values which it would replace and the idea could not be undertaken competitively except perhaps to stretch out the life of a nearly amortized investment. This proposal, it must be emphasized, helps only hardness pollution -- not sodium or chloride except if the waste is reused to make fresh brine.

8. Pipe Line Disposal

The wastes from an alkali factory are of no consequence downstream where the dilution of tributaries has reduced the concentrations of the contaminants to tolerable levels. The pumping power to deliver that far downstream by pipeline would hardly be substantial (the brine is being delivered up to 60 miles or more in some cases) but the investment cost of 100 to 200 miles of pipelines and the maintenance costs would be more than "substantial".

* * *

CHAIRMAN STEIN: At the October '61 meeting it was agreed, in addition to the other conclusions reached, that the Public Health Service would undertake by a study to bring up to date the information and base its report on this at the first session of the conference. We will later call on their representatives to look into that.

In addition it was agreed that the Public Health Service would cause to be made an economic evaluation and we will have an economic report.

In addition to that, it was agreed that we would look into the possibility of TVA releases alleviating the condition, and it was agreed that Olin Mathieson would have an opportunity, of course, to review Dr. Deutsch's paper and its own operation and the Olin Mathieson Corporation would be given an opportunity to make a statement here.

With that, I should like to call on Mr. John Thoman of the Public Health Service for the statement of the Department of Health, Education and Welfare. Mr. Thoman.

MR. THOMAN: I have no statement to give myself. Mr. Al West, who is in our field operations branch at the Sanitary Engineering Center in Cincinnati has updated and brought up to date the data that was presented at the first session of the conference.

Without further ado, Mr. West, would you proceed.

CHAIRMAN STEIN: Mr. West, before you proceed, I would like to ask that anyone making a fairly long statement come up to the lectern and make it. Before you make a statement, for the purposes of the record, it would be appreciated if you gave your name and affiliation. If you have any written material, it is suggested that you give a copy of that material to the reporter to facilitate the taking of the record. Thank you.

MR. AL. WEST: Mr. Chairman, conferees, ladies and gentlemen: The United States Public Health Service was asked to update the data that were included in the 1960 report. We have, with the cooperation of everybody involved, gathered the most recent information, analyzed it, processed it and put it together in this report, which is a comparison of the most recent data in the years of 1958 to 1962 -- 1961 with the 1952-56 data which form the basis for the original report. This report is divided into three sections.

Incidentally, I would like to place the entire report in the record. The reporter has a copy of the entire report.

CHAIRMAN STEIN: Just a moment. As I understand it, you are going to summarize the report and this entire report contains the data on which it is based?

MR. WEST: Yes. It contains most of the calculations and the monthly tabulations, not the raw data. Raw data would include volumes of chemical analyses and calculations.

CHAIRMAN STEIN: Without objection, we will put this in the record. However, you do know that these records sometimes take a little time to come out. Do you have copies of the full report to give to the two states and Olin Mathieson at least before the record appears?

MR. WEST: The two states, or rather the regional office, had 20 copies each. I think they distributed them to the states.

CHAIRMAN STEIN: How about the industry?

MR. WEST: That would be distributed by the state, not by us. We have another 20 or so copies with us.

CHAIRMAN STEIN: Okay. I think industry representatives, they have it. Without objection this will be in the report, because, as you know, sometimes our transcripts don't get out for six months. We wouldn't want to be without it.

MR. WEST: Okay. The report is divided into three parts. In the appendix we actually show the monthly tabulations and we show the range of the river quality, and the maximums and the minimums along with the average. Then the main body of the report includes the discussion, a detailed discussion of the data.

Now that is presented for critical review at your convenience. Then we also have part one, which is the preface and the summary and the conclusions. We hope that the summary and conclusions do stand on their own feet. So in the interest of time, I will read the summary and conclusions of this report and make a few references to the body of the report, so if I may now proceed, I will start with the preface, which starts with the 1960 report.

By the way, as we get into this, I would like to refer to the charts and Mr. Pearce Klazer, who worked with us in developing this report and who you will hear from later, will help and point out the stations.

CHAIRMAN STEIN: In the record the charts will appear as they appear in this bound report.

MR. WEST: The charts will appear in the bound report, although they will be in black and white in the record, where we have the color up here to make it more evident. I might also say, as I get into it, in the record there is Table A, which is really the grand summary of all the information. We don't have a chart to discuss here, but all the information on these charts really are pulled directly from this Table A and Table A also is included in the report and will go in the conference notes.

. . . Mr. West presented a summary of the report and Mr. Klazer exhibited the charts and graphs. The report, in full, is set out as follows . . .

FEBRUARY 1962 SUPPLEMENT
to the
SEPTEMBER 1960 REPORT
on
POLLUTION OF INTERSTATE WATERS
of the
NORTH FORK HOLSTON RIVER
and of
HOLSTON AND TENNESSEE RIVERS
VIRGINIA - TENNESSEE

U. S. Department of Health, Education and Welfare
Public Health Service
Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

February 1962

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PART I

PREFACE

1960 REPORT

Pollution of the Holston River System is described in the September 1960 Report on Pollution of the North Fork Holston River and of Holston and Tennessee Rivers; Virginia-Tennessee. That document will be referred to as the "1960 Report" or "Report".

A resume of past pollution problems, orders by the Virginia State Water Control Board, action by the Olin Mathieson Chemical Corporation, and the Tennessee Stream Pollution Control Board's request for a conference on interstate pollution are described in the 1960 Report. The Report presents information regarding wastes discharged to the North Fork of the Holston River by the Olin Mathieson Chemical Corporation. It also describes the watershed, identifies water uses and discusses the effects of pollution on water quality. The Report then summarizes economic losses attributed to pollution of the Holston River System.

The final conclusion of the 1960 Report is quoted as follows:

"It is evident that pollution of the North Fork Holston River by the Olin Mathieson Chemical Corporation constitutes pollution of interstate waters subject to abatement under the Federal Water Pollution Control Act, as such pollution endangers the health or welfare of persons in a state other than that in which the discharge contributing to such pollution originates."

1962 SUPPLEMENT

The tables, charts and discussion of the 1960 Report are based on average conditions over a five-year span from 1952 through 1956. The report on pollution loads and water quality is brought up to date in this February 1962 Supplement to the 1960 Report. This current document will be referred to as the "1962 Supplement" or "Supplement".

In as far as possible, all current data available for the three water years from October 1958 through September 1961 is included in this current Supplement. Water years, extending from October 1st of one calendar year through September 30th of the succeeding year, were selected as logical interval periods and cutoff points for current data analysis. This permitted direct use of U.S.G.S. stream discharge records which are reported, and averaged, on a water-year basis. On this basis, it was also possible to bring the annual summaries right up to date even though October, November and December 1961 data were not available.

Where data were available, the summaries show the most recent annual averages during the October 1960 - September 1961 water year. Wherever possible, a longer term, and more representative, average of the past three water years was also determined. Conditions during the last year, and the average of the last three years, are compared with those which prevailed during the 1952-1956 period.

CONFERENCE ON INTERSTATE POLLUTION

According to the provisions of Section 8 of the Federal Water Pollution Control Act (33 U.S.C. 466 g (c)), the Surgeon General on August 5, 1960, called a conference in the matter of pollution of interstate waters of the North Fork of the Holston River (Virginia-Tennessee). The first session of this conference was held on September 28, 1960 in the auditorium of the Kingsport Utilities Company, Kingsport, Tennessee. A Summary of the September 28th conference is included in this Supplement.

SUMMARY AND CONCLUSIONS

RIVER WATER QUALITY

Table A and Figures A and B, following this section, enumerate and illustrate the comparison between the original 1952-56 and the recent 1958-61 river water quality data. Particularly significant results and comparisons are summarized as follows:

1. North Fork of the Holston River, below Olin Mathieson, at Mile NH-78.1.

At this point the river contains approximately 2,400 mg/l hardness and 2,500 mg/l chlorides, which are about 14 per cent below the 1952-1956 averages. The mass of hardness is reduced 11 per cent.

2. North Fork of the Holston River, near Gate City, at Mile NH-8.8.

At this point the river contains approximately 1,200 mg/l hardness and 1,000 mg/l chlorides, which are about 5 per cent below the 1952-1956 averages.

The average mass of hardness increased 5 per cent and the mass of chlorides decreased 10 per cent from the 1952-56 averages.

3. Holston River at John Sevier Steam Plant, at Mile H-106.5.

Hardness concentrations of approximately 210 mg/l and chlorides at approximately 105 mg/l almost equal the 1952-1956 averages.

The average mass of hardness and chlorides, for the three recent water years, is 10 per cent and 16 per cent respectively below the 1952-1956 average. During 1960-61 the chloride mass again approximates the 1952-1956 average.

4. Holston River at North East Knox Utility water treatment plant, at Mile 5.5.

The 1960-1961 data shows 162 mg/l hardness and 58 mg/l chlorides. These reductions of 21 per cent and 34 per cent are extreme and do not conform to the trend of other related data.

The calculated masses of hardness and chlorides, based on the 1960-1961 data, are also lower than the 1952-1956 average by 14 per cent and 19 per cent respectively.

5. Tennessee River at Knoxville Utility water treatment plant, at Mile T-649.2.

At this point the river contains approximately 98 mg/l hardness and 33 mg/l chlorides. These values represent 8 per cent and 15 per cent reductions below the 1952-1956 averages. The mass increases approximately 17 per cent. These variations are materially influenced by the increased 1960-1961 discharge of the more dilute French Broad tributary.

COMPARISON BETWEEN
ORIGINAL 1952-56 AND RECENT 1958-61 DATA
FOR THE HOLSTON RIVER SYSTEM

DISCHARGE, HARDNESS AND CHLORIDES

TABLE A

	VIRGINIA				TENNESSEE				
	NORTH FORK HOLSTON RIVER					HOLSTON RIVER			
	Above Saltville	From Olin Mathieson	Below Olin Mathieson	At Gate City	South Fork Holston River	Near Rogersville	Above Knoxville*	French Broad River*	Tennessee River At Knoxville*
STREAM DISCHARGE (cfs)									
1952-56 Avg.	261	-	261	781	2,150	3,370	4,120	6,120	10,260
1958-61 Avg.	262	-	262	796	2,511	3,620	4,480	7,302	13,595
% CHANGE	+1	-	+1	+2	+17	+7	+9	+19	+33
HARDNESS									
Concentration (mg/l)									
1952-56 Avg.	101	-	2,694	1,240	108	210	204	47	106
1958-61 Avg.	113	-	2,379	1,177	-	207	162	52	98
% CHANGE	+12	-	-12	-5	-	-1	-11	+11	-8
Amt. Attributed to O.M. 1952-56	0	-	2,530	990	0	88	71	0	28
Amt. Attributed to O.M. 1958-61	0	-	2,260	800	0	87	66	0	20
Mass (lbs/day)									
1952-56 Avg.	113,000	1,595,000	1,708,000	1,989,000	1,395,000	3,811,000	4,537,000	1,550,000	6,087,000
1958-61 Avg.	79,000	1,438,000	1,517,000	2,087,000	1,460,000	3,434,000	3,902,000	1,915,000	7,164,000
% CHANGE	-30	-10	-11	+5	+5	-10	-14	+23	+18
% Attributed to O.M. 1952-56	0	100	96	80	0	42	35	0	25
% Attributed to O.M. 1958-61	0	100	95	68	0	42	27	0	20
CHLORIDES									
Concentration (mg/l)									
1952-56 Avg.	2	-	2,986	1,070	9	107	88	7	39
1958-61 Avg.	5	-	2,531	1,025	-	102	58	8	33
% CHANGE	+150	-	-15	-4	-	-5	-34	+14	-15
Amt. Attributed to O.M. 1952-56	0	-	2,986	1,070	0	102	83	0	33
Amt. Attributed to O.M. 1958-61	0	-	2,531	990	0	100	-	0	21
Mass (lbs/day)									
1952-56 Avg.	2,400	1,641,000	1,843,000	1,849,000	96,000	1,950,000	1,958,000	232,000	2,190,000
1958-61 Avg.	3,000	1,611,000	1,614,000	1,656,000	-	1,649,000	1,578,000	305,000	2,537,000
% CHANGE	+25	-12	-12	-11	-	-16	-19	+31	+16
% Attributed to O.M. 1952-56	0	100	100	100	0	95	94	0	84
% Attributed to O.M. 1958-61	0	100	100	97	0	98	(105)	0	65

*NOTE: Recent results for the Holston River above Knoxville and for the French Broad and Tennessee Rivers reflect the 1960-1961 average.
All other recent data include the entire three year 1958-61 period.

FIGURE A
HARDNESS
HOLSTON RIVER SYSTEM
1952-56 vs 1956-61

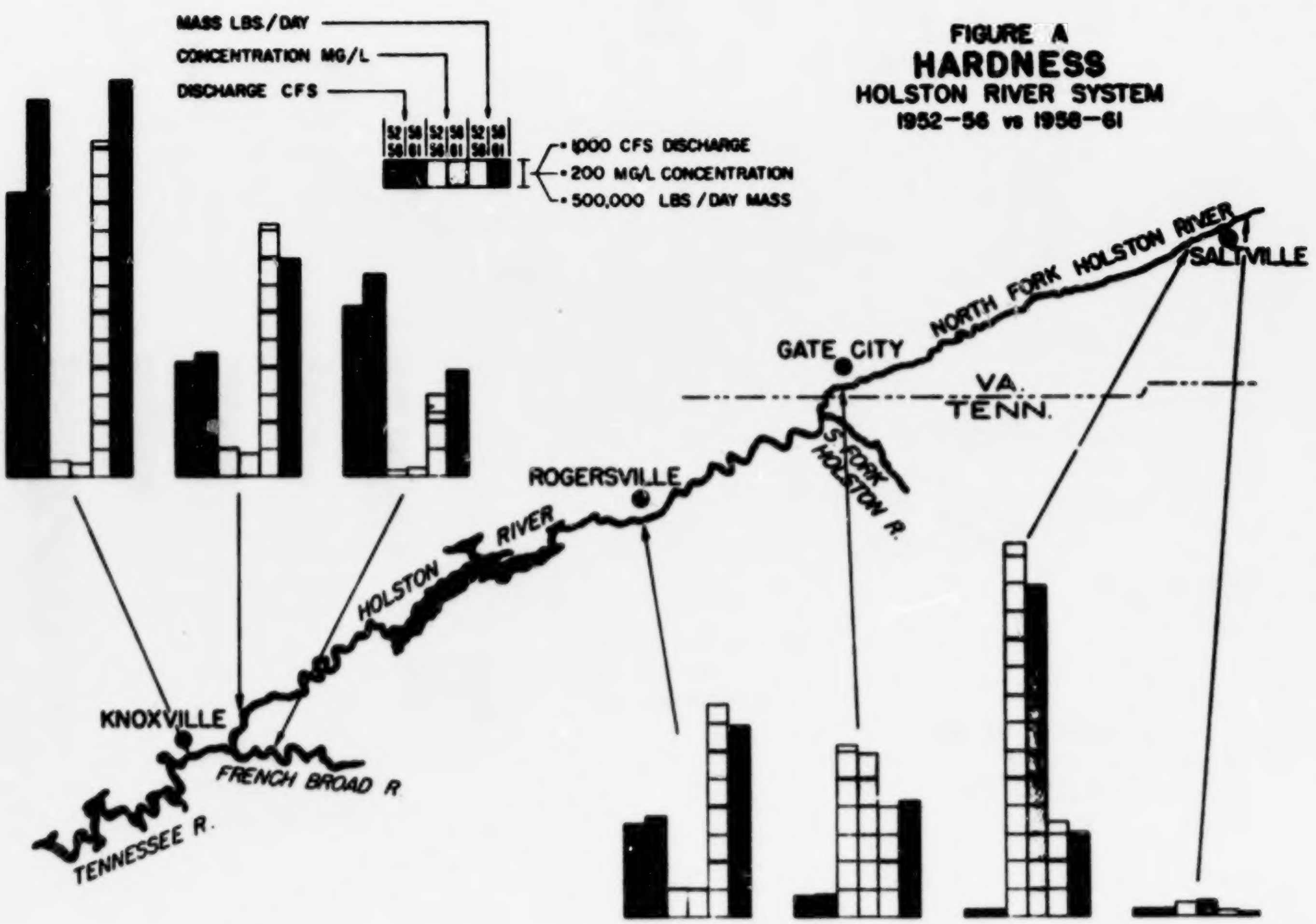
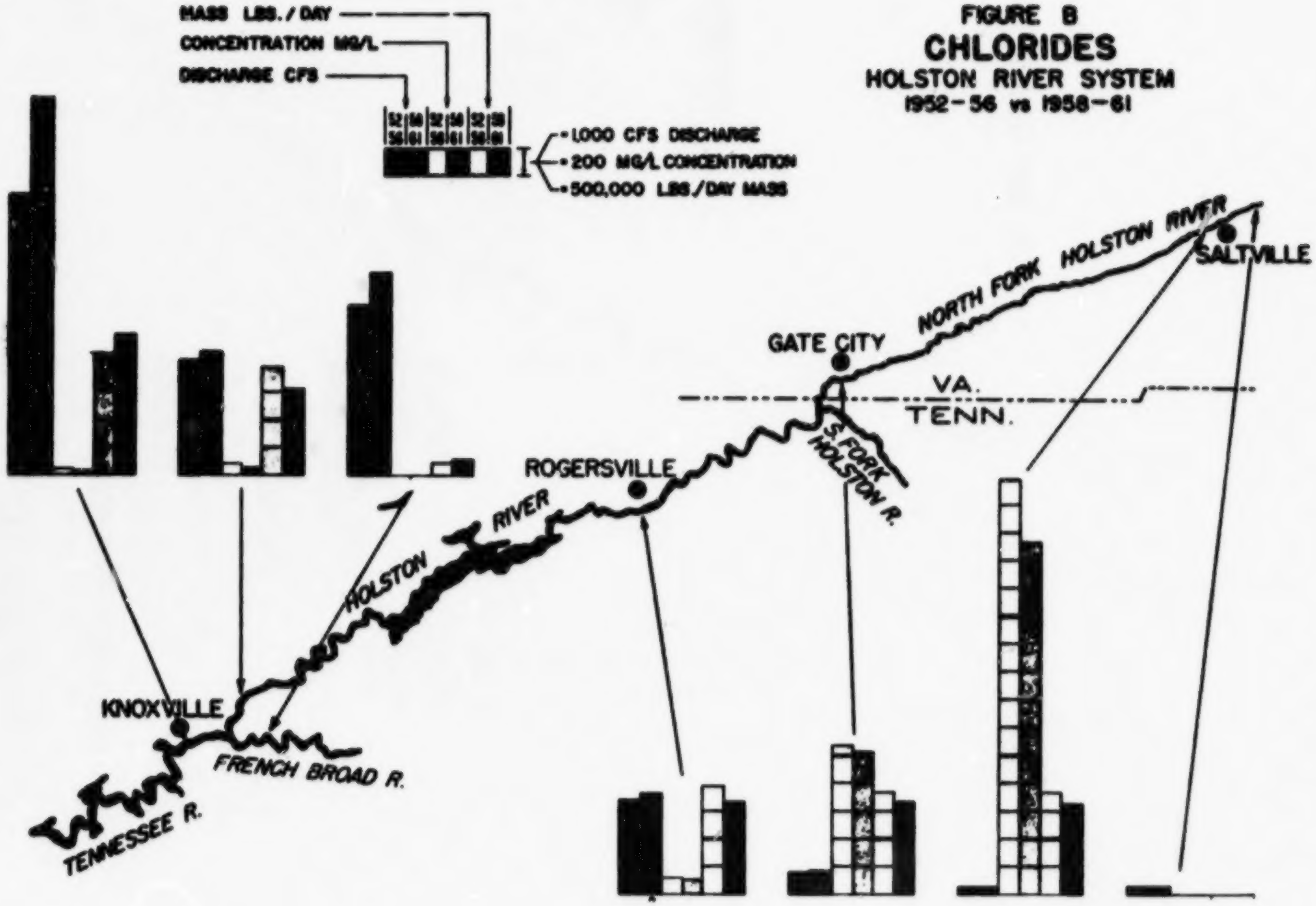


FIGURE 8

CHLORIDES

HOLSTON RIVER SYSTEM

1952-56 vs 1958-61



RELATIVE PERCENTAGE OF OLIN MATHIESON WASTES

Figures C and D, following this section, illustrate the percentage of river water hardness and chlorides attributable to Olin Mathieson waste discharges. These percentages, and comparisons of 1952-56 and 1958-61 data from key sampling stations are summarized as follows:

1. During the 1958-1961 water years, approximately 95 per cent of the hardness and 100 per cent of the chlorides in the North Fork of the Holston River, below Saltville, Virginia are attributed to the wastes discharged from the Olin Mathieson plant in Saltville. These values are almost identical to the 1952-1956 averages of 93.8 per cent and 99.8 per cent respectively.

2. During the 1958-1961 water years, approximately 68 per cent of the hardness and 97 per cent of the chlorides in the North Fork of the Holston River, near Gate City, Virginia where it flows into the State of Tennessee, are attributable to the wastes discharged from the Olin Mathieson plant in Saltville, Virginia. The equivalent 1952-1956 averages are 80.2 per cent and 99.6 per cent respectively.

3. Near Rogersville, Tennessee the 1958-61 hardness percentage of 41.6 is practically identical with the 41.8 percentage for the 1952-56 period. The chloride percentage varied only slightly between 94.5 during 1958-61 and 97.8 during 1952-56.

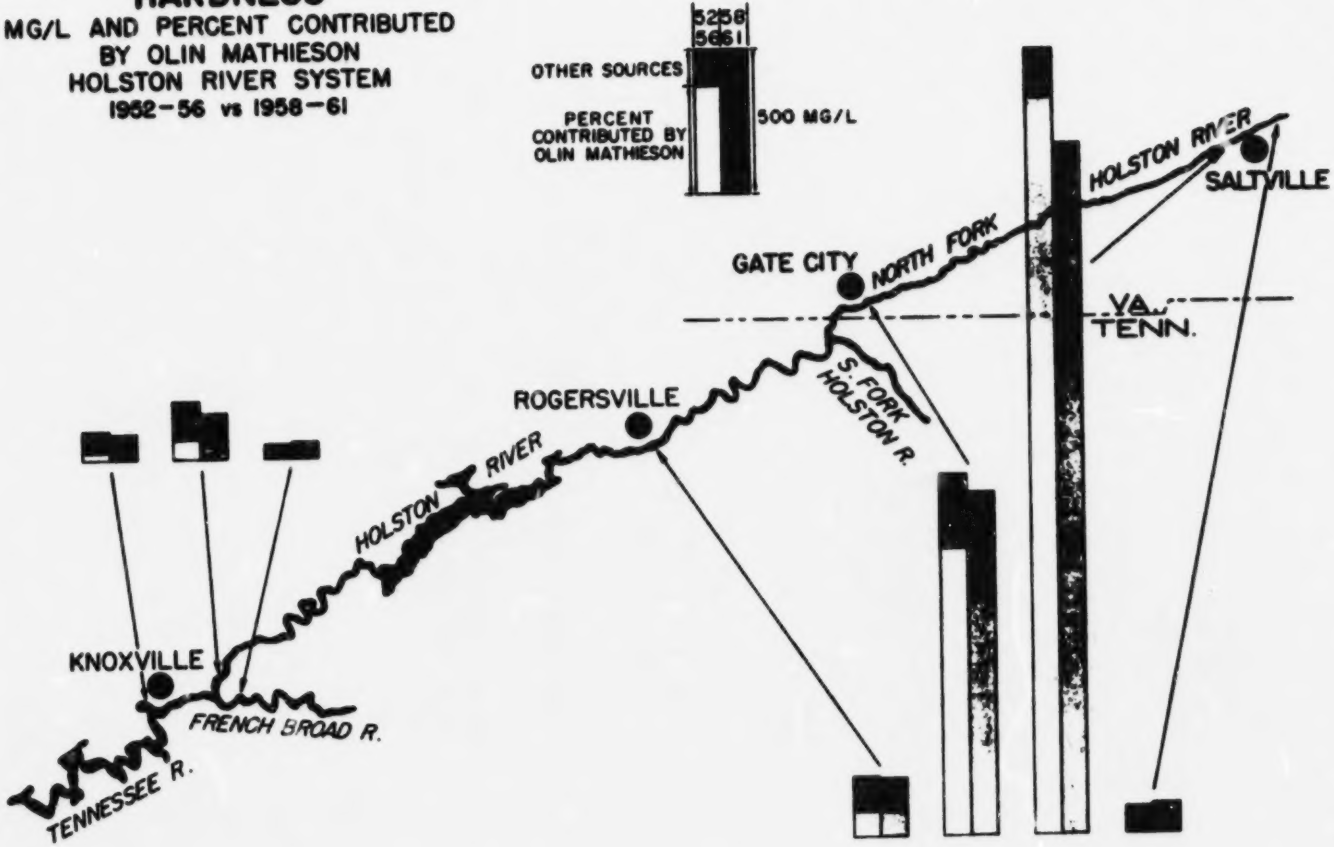
4. It was not possible to develop an accurate comparison between these two periods for the Holston River station above Knoxville.

5. During the 1960-1961 water year approximately 20 per cent of the hardness and 65 per cent of the chlorides in the Tennessee River, at Knoxville, Tennessee are attributable to the Olin Mathieson waste discharges. The equivalent 1952-1956 averages are 26 per cent and 84 per cent respectively.

FIGURE C

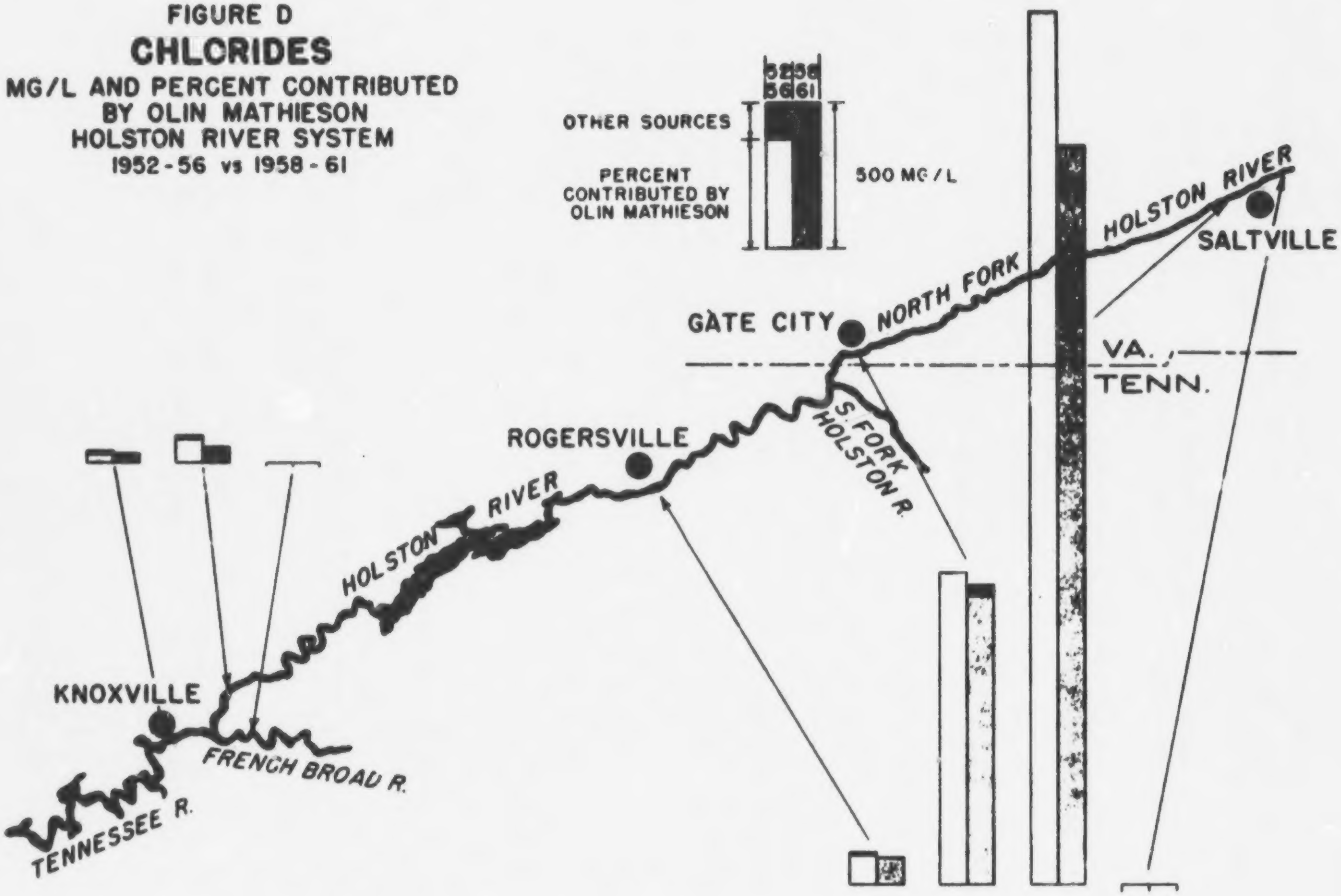
HARDNESS

MG/L AND PERCENT CONTRIBUTED
BY OLIN MATHIESON
HOLSTON RIVER SYSTEM
1952–56 vs 1958–61



52 56
58 61
OTHER SOURCES
PERCENT CONTRIBUTED BY OLIN MATHIESON
500 MG/L
HOLSTON RIVER
SALTVILLE
GATE CITY
NORTH FORK
VA.
TENN.
S. FORK HOLSTON R.
ROGERSVILLE
HOLSTON RIVER
KNOXVILLE
FRENCH BROAD R.
TENNESSEE R.

FIGURE D
CHLORIDES
MG/L AND PERCENT CONTRIBUTED
BY OLIN MATHIESON
HOLSTON RIVER SYSTEM
1952-56 vs 1958-61


52
56
58
61
OTHER SOURCES
PERCENT
CONTRIBUTED BY
OLIN MATHIESON
500 MG/L
HOLSTON RIVER
SALTVILLE
NORTH FORK
GATE CITY
VA.
TENN.
S. FORK
HOLSTON R.
ROGERSVILLE
HOLSTON
RIVER
KNOXVILLE
FRENCH BROAD R.
TENNESSEE R.

EFFECT OF DISCHARGE ON WATER QUALITY

1. River water quality variations, between the 1952-56 and 1958-61 periods, are also influenced by changes in precipitation, runoff and discharge.

2. Water quality variations in the North Fork Holston River are attributed primarily to changes in pollutional loading.

3. Water quality variations in the Holston River are due to changes in both pollutional loadings and river discharge rates.

4. Increased river discharge, rather than reduced pollutional loading, is primarily responsible for reduced hardness and chloride concentrations in the Tennessee River at Knoxville.

POLLUTION LOADS

1. Calcium and sodium chloride wastes discharged to the North Fork Holston River by the Olin Mathieson Chemical Corporation at Saltville, Virginia, cause interstate pollution of these waters flowing from Virginia into Tennessee.

2. Approximately 1,440,000 pounds per day of hardness and 1,610,000 pounds per day of chlorides were discharged to the North Fork of the Holston River by the Olin Mathieson Chemical Corporation during the three recent water years from October 1958 through September 1961.

3. This recent average waste discharge from the Olin Mathieson plant is approximately 11 per cent less than the average load during the 1952-1956 period covered by the "1960 Report".

4. The disproportionately high hardness load during the 1954 raised the 1952-56 average significantly above the more uniform values experienced during each of the other four years.

5. The most recent hardness loads from Olin Mathieson practically equal the average load that prevailed during four of the five years within the 1952-1956 period of the "1960 Report".

6. After reaching a long term low in 1958, the trend of hardness below Olin Mathieson reversed and increased slightly during the last three years of record. This trend is illustrated in the following Figure E.

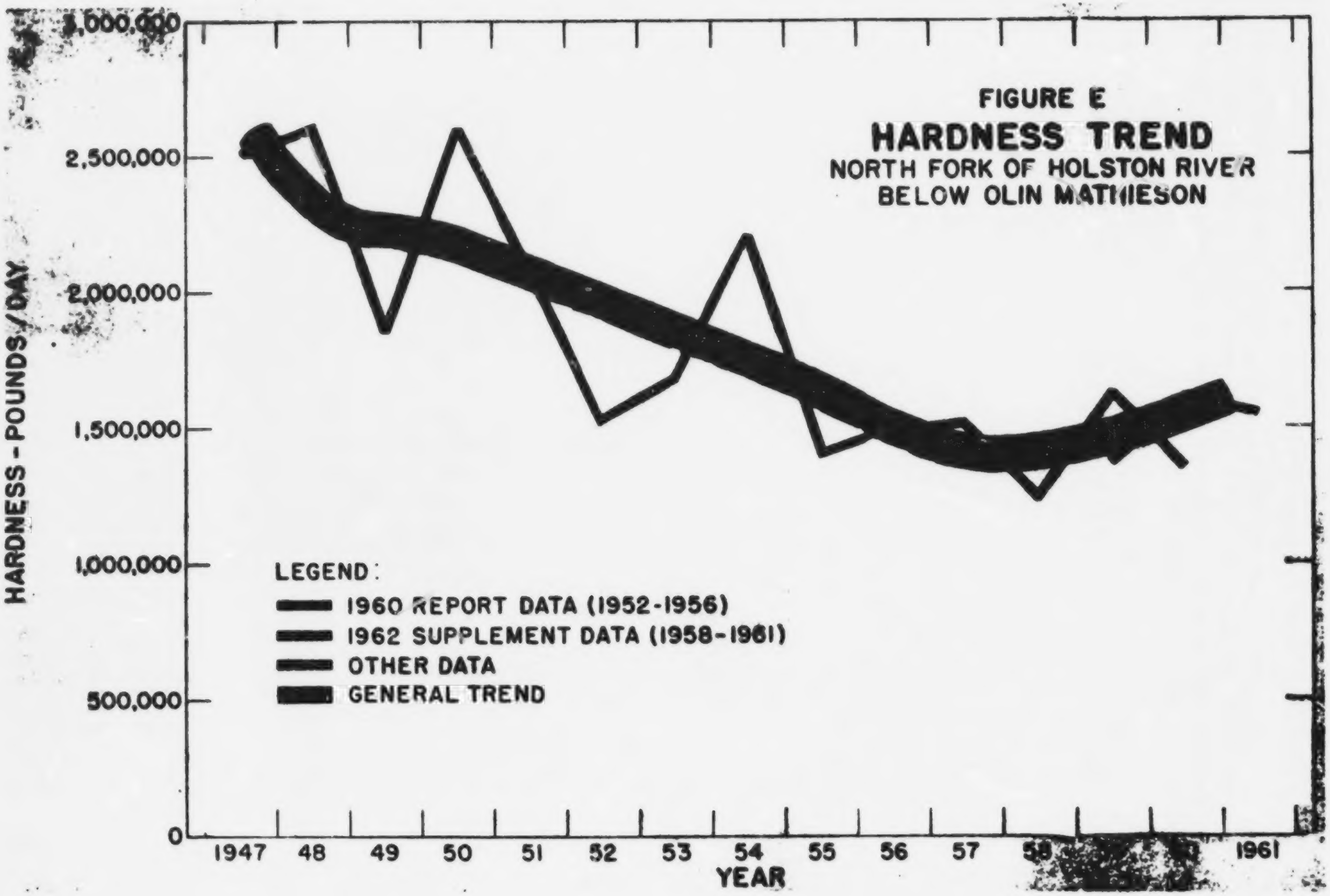


FIGURE E

HARDNESS TREND

NORTH FORK OF HOLSTON RIVER
BELOW OLIN MATHIESON

CONCLUSIONS

1. Data collected during the three most recent water years, from October 1958 through September 1961, generally confirms the "1960 Report" of average pollutional loads and river water quality that occurred during the 1952-1956 period.

2. An interstate pollution problem, subject to abatement under the Federal Water Pollution Control Act, continues to exist.

PART II

DISCUSSION

HOLSTON RIVER SYSTEM - LOCATION GUIDE

(Virginia - Tennessee)

Sampling Stations, Flow Gaging Stations, and Reference Point Locations by River Mile Above Mouth

NORTH FORK HOLSTON RIVER

NH-84.9	U.S.G.S. Flow Gage. (Originally identified as NH-81.5)*
NH-84.4	"Above Saltville" Station. Va. 91 Bridge. (Orig. ident. NH-81.1)*
NH-81.5	Henrytown Bridge. Below O. M. Muck Ponds. (Orig. ident. NH-78.1)*
NH-77.8	"Below Saltville". Footbridge above Tumbling Creek.
NH-77.7	Tumbling Creek enters. (L) U.S.G.S. Gage at TC-0.12.
NH-70.1	Wolf Creek enters. (L) U.S.G.S. Gate at WC-0.84.
NH-69.8	"Meadow View" Station. Va. 80 Bridge. "Hayter's Gap Station".
NH-69.8	Logan Creek enters. (R) U.S.G.S. Gage at LC-0.13.
NH-63.5	Brumley Creek enters. (L) U.S.G.S. Gage at BC-0.19.
NH-59.3	"Holston" Station. U.S. 19 Bridge Crossing. (Orig. ident. NH-58.1)*
NH-59.3	U.S.G.S. Flow Gage. Old Records.
NH-28.2	Cove Creek enters. (R) U.S.G.S. Gage at CC-2.4.
NH-22.2	"Hilton" Station. U. S. 58 & 421 Bridge.
NH-10.2	Big Moccasin Creek enters. (L) U.S.G.S. Gate at BM-2.4.
NH-8.8	U.S.G.S. Flow Gage.
NH-8.8	"Gate City" Station. U. S. 23 Bridge.
NH-5.5	Possum Creek enters. (L) U.S.G.S. Gage at PC-3.0.
NH-0.0	Confluence So. Fork to form Holston R. (H-142.2).

SOUTH FORK HOLSTON RIVER

SH-8.2	Fort Patrick Henry Dam.
SH-6.0	Kingsport Water Works Intake.
SH-3.7	U.S.G.S. Flow Gage.
SH-0.5	"River Mouth" Station.
SH-0.0	Confluence No. Fork to form Holston R. (H-142.2).

HOLSTON RIVER

H-142.2	North & South Forks join to form Holston.
H-137.9	Road bridge over Holston at Holston Ordnance Works.
H-131.5	"Church Hill" sampling station.
H-118.8	U.S.G.S. Flow Gage 1500' above Surgoinsville Bridge.

H-118.5	Surgoinsville Co. Road Bridge.
H-109.1	Big Creek enters. (L) U.S.G.S. Gage at BC-2.0.
H-108.8	Beech Creek enters. (R) U.S.G.S. Gage at BC-6.58.
H-106.5	John Sevier Steam Plant.
H-104.2	"Old Rogersville" sampling & gaging station.
H-89.2	Poor Valley Creek enters. (L) U.S.G.S. Gage at PV-6.20.
H-75.2	Morristown, Tennessee Water Works Intake. Hwy. 25 & 32.
H-52.4	Mossey Creek enters. (R) U.S.G.S. Gage at MC-4.39.
H-52.3	Outlet Cherokee Dam. Hwy. 92 crossing.
H-52.0	U.S.G.S. Flow Gage.
H-30.4	Beaver Creek enters. (R) U.S.G.S. Gage at BC-2.02.
H-27.1	Richland Creek enters. (L) U.S.G.S. Gage at RC-4.66.
H-14.0	Big Flat Creek Enters. (L) U.S.G.S. Gage at BF-2.17.
H-12.2	Huffaker Ferry sampling station.
H-9.5	North East Knoxville Utility - Water Plant Intake. (R)
H-5.5	U.S.G.S. Flow Gage. Ruggles Ferry Bridge.
H-1.8	Boyd Bridge sampling station.
H-0.0	Confluence with French Broad to form Tennessee R. at (T-652.1).

FRENCH BROAD RIVER

FB-31.3	U.S.G.S. Flow Gage. 1.0 mile below Douglas Dam.
FB-12.2	Huffaker Ferry Station.
FB-7.5	U.S.G.S. Flow Gage, Riverdale Ferry.
FB-3.9	Knoxville-Chapman Utility District Water Intake.
FB-0.0	Confluence with Holston R. to form Tennessee R. (T-652).

TENNESSEE RIVER

T-652	Headwater at mouth of Holston & French Broad.
T-651.4	U.S.G.S. Flow Gage.
T-649.2	Knoxville Utility District Water Works Intake.
T-635.7	Little River enters. (R)
T-601.6	Lenoir City Station.

* River mile locations, shown in the left-hand column, have been corrected to conform with the latest official data which was received after final drafts of the tables and discussions were completed. The original designations for four of these stations (NH-81.5, NH-81.1, NH-78.1 and NH-58.1), which are used to identify stations in the 1960 Report and the 1962 Supplement tables and discussions, are shown in parentheses.

SOURCES OF DATA

This 1962 Supplement summarizes the most recent information on pollution of the North Fork of the Holston River and water quality in the North and South Forks of the Holston River, the Holston River, the French Broad River at its mouth, and the upper reach of the Tennessee River. It evaluates hardness and chlorides data for the three water years from 1958 to 1961 and brings the 1952-1956 summaries of the 1960 Report up to date.

The summary is based on data furnished by agencies, companies and individuals officially concerned with the quality of these waters.

All river discharge records were furnished by the United States Geological Survey.

Chemical quality data were furnished by the following organizations. Data related to the North Fork of the Holston River were provided by the Virginia State Water Control Board.

Water quality below Saltville is based on the laboratory reports submitted to the Virginia Water Control Board by the Olin Mathieson Chemical Corporation.

Hardness analyses of the mouth of the South Fork of the Holston River were provided by the Kingsport, Tennessee Water Utility District.

Tennessee Valley Authority furnished data at the John Sevier Steam Plant location and other points of the Holston River. The Morristown, Tennessee Water System provided reports on the quality of the Holston River in Cherokee Lake.

Samples were collected near the mouth of the Holston River by the North East Knoxville Utility District; near the mouth of the French Broad River by the Knox-Chapman Utility District, and at the upper Tennessee River by the Knoxville Utility District. These samples were collected daily and all laboratory analyses were performed by the Knoxville Utility District.

This data was correlated, summarized and evaluated by the Public Health Service at the Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio.

DESCRIPTION OF RIVER WATERS

CONCENTRATION OF HARDNESS AND CHLORIDES

Figures I and II depict the hardness and chloride concentrations along the North Fork Holston, the Holston, and the Tennessee Rivers from Saltville, Virginia to Knoxville, Tennessee. These figures are included to illustrate the relationship between the data from the 1952-1956 water years, the 1958-1961 water years and the 1961 water year. Due to the lack of sufficient data, some erratic mean hardness and chloride concentrations are evident, particularly for the 1961 water year. The 1952-1956 data are based upon long-term sampling and assumed tributary concentrations, which results in a continuous and consistent representation of the hardness and chloride concentrations.

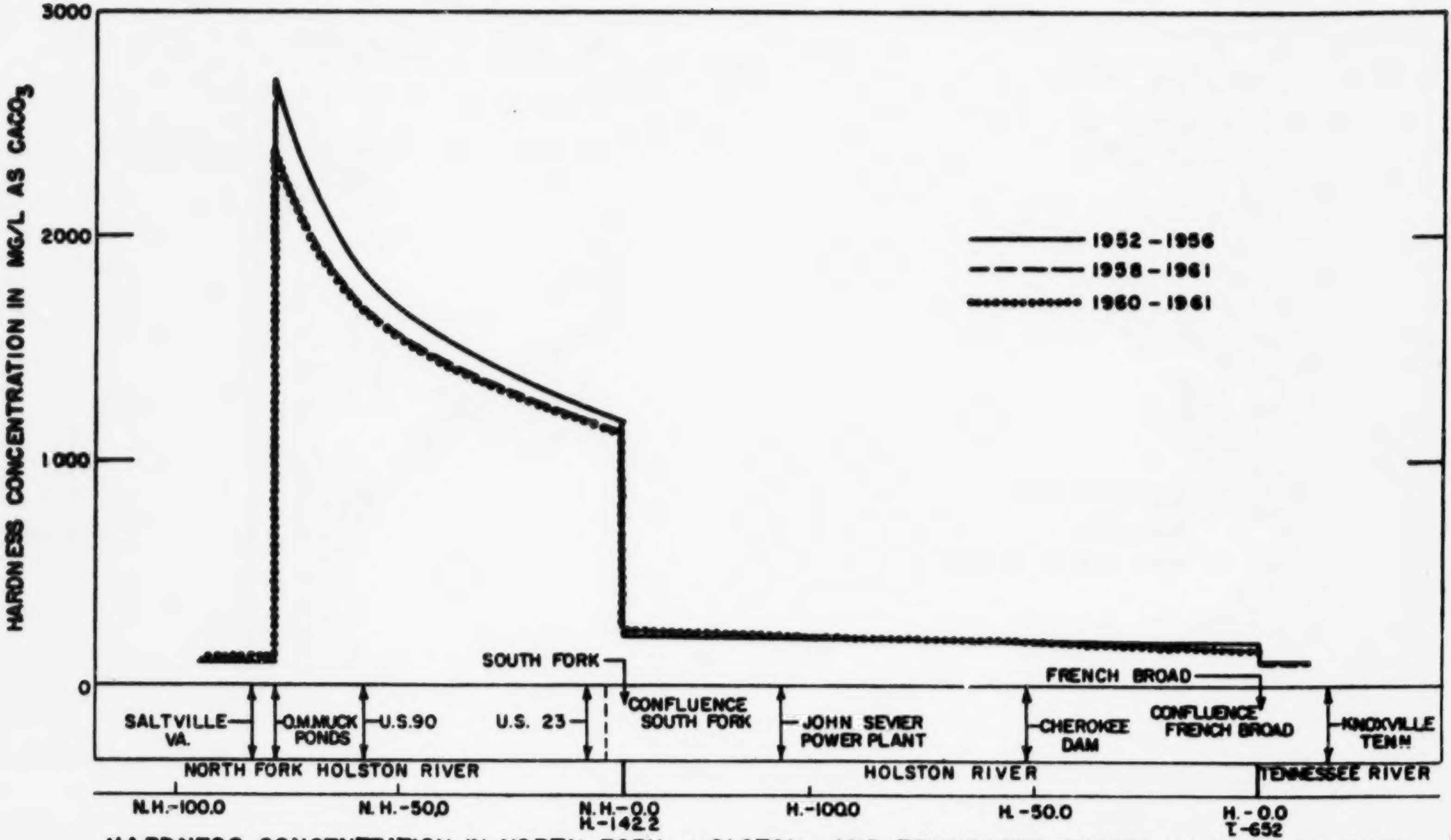
The natural hardness and chloride concentrations of the North Fork of the Holston River above Saltville continues to average about 120 mg/l and 6 mg/l respectively.

Below the Olin Mathieson waste outfall, a sharp rise in the mean hardness and chloride concentrations is evident. The more recent data from the 1958-1961 and 1961 water years show a mean hardness concentration of nearly 2400 mg/l as $CaCO_3$, which is slightly less than the 1952-1956 mean of 2700 mg/l. The more recent data similarly indicate a sharp rise in the mean chloride concentration to just over 2500 mg/l, which is also less than the 1952-1956 mean of nearly 3000 mg/l.

Due primarily to tributary dilution, the mean hardness and chloride concentration of the North Fork between Saltville and the mouth are reduced by over 50 per cent. At the Virginia-Tennessee state line, just above the confluence with the South Fork Holston, the mean hardness is well over 1100 mg/l and similarly the mean chloride concentration exceeds 1000 mg/l.

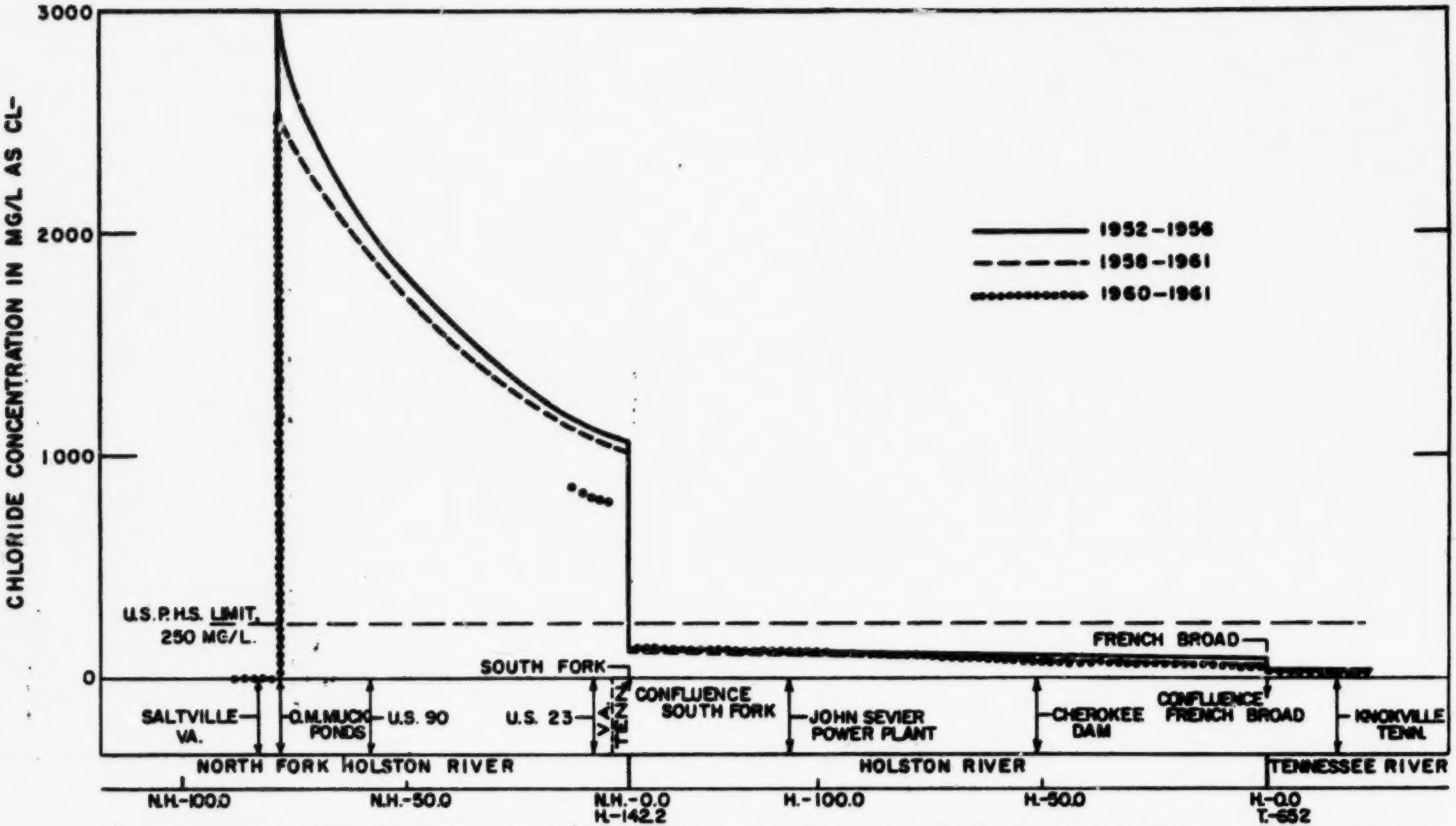
The South Fork Holston, with historically about three times the flow of the North Fork along with negligible chlorides and a rather consistent hardness of less than 120 mg/l, dilutes the excessive hardness and chloride concentration of the North Fork down to means of just over 200 mg/l and 100 mg/l respectively. From the confluence of the North and South Fork to the Tennessee River, the hardness and chlorides are slightly diluted by the tributary waters of the Holston River.

The Holston River joins the French Broad River above Knoxville, Tennessee to form the Tennessee River. The somewhat higher flow, softer water, and low chloride content of the French Broad reduce the hardness and chloride concentrations of the Tennessee River to about one-half those of the Holston. Although it is apparent that the hardness and chloride concentrations in the North Fork below Olin Mathieson have been reduced since the 1952-1956 water years, the direct effect



HARDNESS CONCENTRATION IN NORTH FORK, HOLSTON, AND TENNESSEE RIVERS IN MG/L AS $CACO_3$

FIGURE I



CHLORIDE CONCENTRATION IN NORTH FORK, HOLSTON, AND TENNESSEE RIVERS IN MG/L AS CL-

FIGURE II

on the downstream concentrations has been relatively small. In these lower reaches, the concentration levels are more responsive to river discharge variations.

MASS OF HARDNESS AND CHLORIDES

Figures III and IV show the hardness and chloride loading in thousand pounds per day on the North Fork, Holston, and Tennessee Rivers from Saltville, Virginia to Knoxville, Tennessee. Since the determination of mass is a function of flow and concentration, inconsistencies result from intermittent sampling on days of erratic flows or concentrations, as well as sampling at points on the river where the quality is not homogeneous. This is especially evident for the more recent data along the Holston and Tennessee Rivers. For this reason, the 1958-1961 and 1961 water year curves are discontinuous. Erratic means, however, are shown as short curve segments.

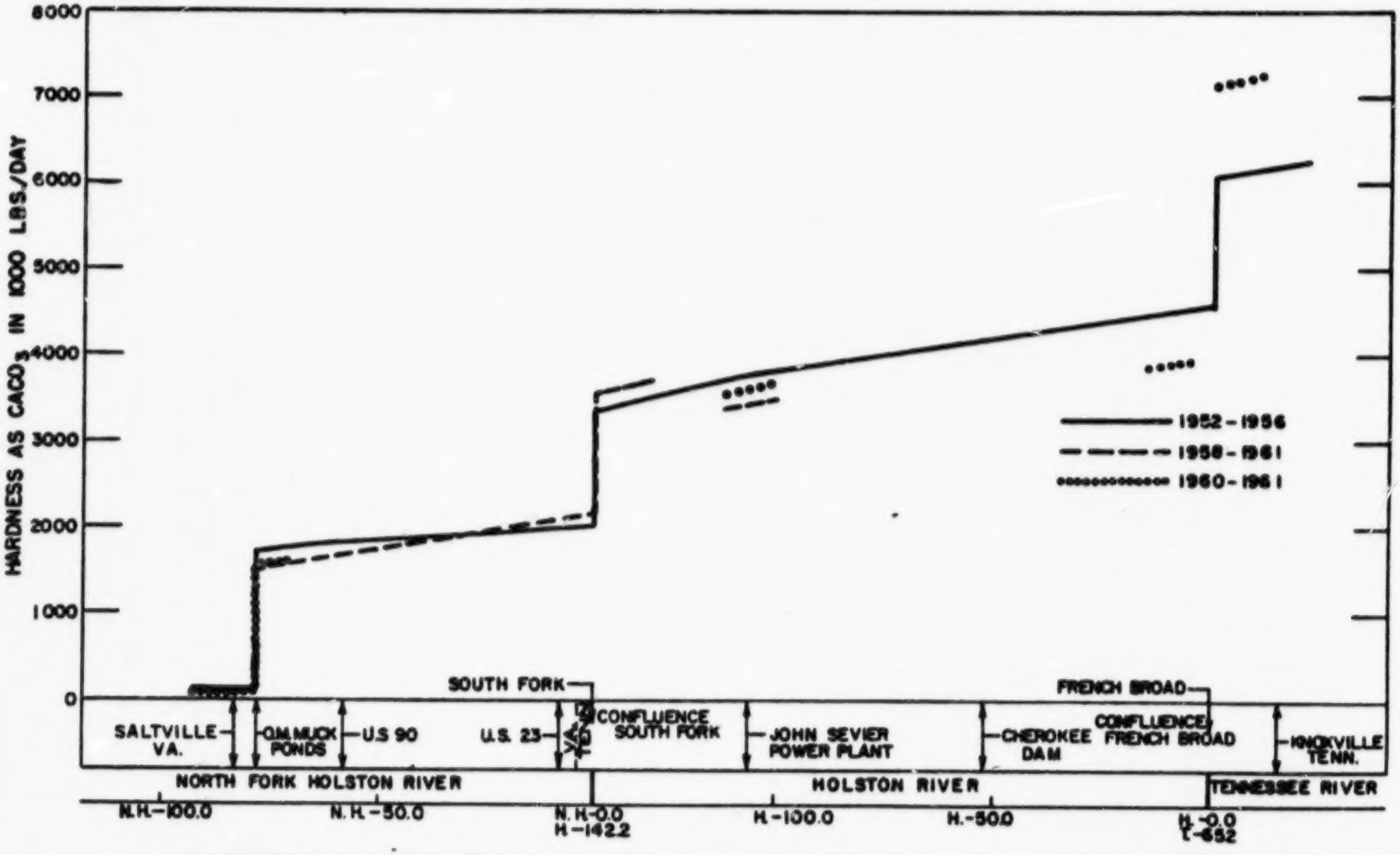
The North Fork above Saltville indicates a rather constant hardness and low chloride contribution. There is the same pronounced increase in hardness and chloride load in the North Fork below the Olin Mathieson waste outfall as is evident in Figures I and II. The mean hardness load at the waste outfall was over 1,500,000 pounds per day for the 1958-1961 and 1961 water years as compared to the mean of approximately 1,700,000 pounds per day for the 1952-1956 water years. The mean chloride load for the 1958-1961 and 1961 water years was 1,650,000 pounds per day as compared to about 1,850,000 for the 1952-1956 water years.

The tributary contribution for the 1952-1956 water years was based on a mean tributary hardness of 100 mg/l as $CaCO_3$, and a mean chloride concentration of 2.0 mg/l as Cl^-. The more recent data indicates a similar contribution from the tributaries.

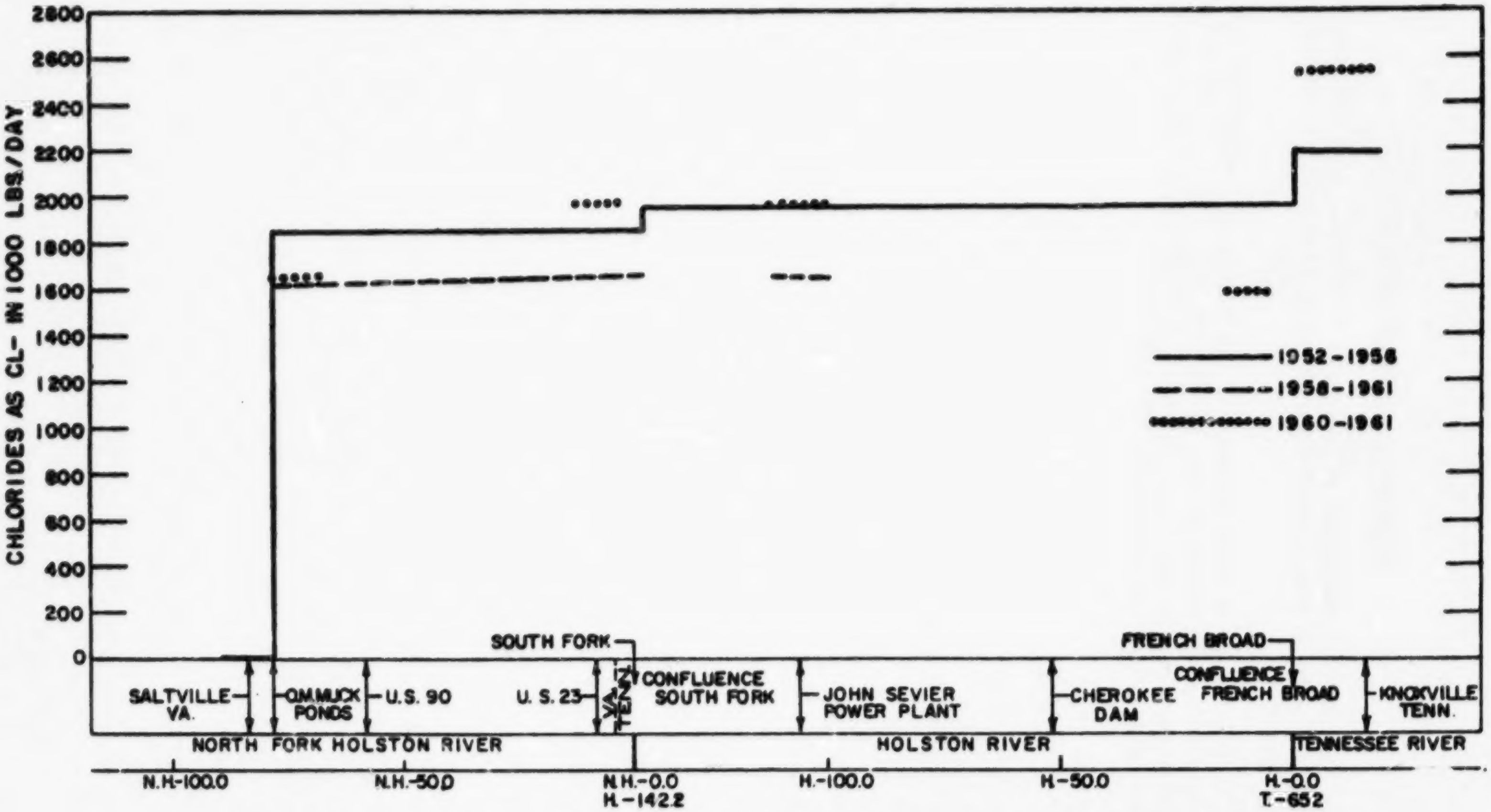
The hardness and chloride loads from the North and South Forks are combined at the confluence below Kingsport, Tennessee. Recent data on the Holston River are too sketchy to determine a consistent mean load. The mean loads as determined from available information result in the erratic values shown.

The hardness and, to a lesser extent, the chloride loads along the Holston River are increased by tributary contributions. The recent tributary load from the French Broad, which also increased above the 1952-1956 averages, currently amounted to about 2,000,000 pounds per day of hardness and 300,000 pounds per day of chlorides.

The 1960-1961 data from Knoxville show totals of approximately 7,000,000 pounds per day of hardness and 2,500,000 pounds per day of chlorides.



HARDNESS IN NORTH FORK, HOLSTON, AND TENNESSEE RIVERS IN 1000 LBS./DAY
FIGURE III



CHLORIDES IN NORTH FORK, HOLSTON, AND TENNESSEE RIVERS IN 1000 LBS./DAY

FIGURE IV

DISCUSSION OF WATER QUALITY DATA

Individual summaries of the mean discharge, hardness and chloride data for each of the significant sampling stations are assembled in the Appendix.

Station to station summaries, including the comparison of the data during the three periods of record, are shown in the following Tables Nos. 1, 2, and 3. A detailed discussion of the summaries for each sampling station follows the tables.

SUMMARY OF RECENT DATA
ON THE HOLSTON RIVER SYSTEM

DISCHARGE, HARDNESS AND CHLORIDES
FOR THE 1960-1961 WATER YEAR

TABLE 1

SAMPLE STATION LOCATION	RIVER MILE	DISCHARGE IN CFS			HARDNESS AS CaCO3						CHLORIDES AS Cl⁻					
					Concentration in Mg/1			Mass in Thousand Lbs/Day			Concentration in Mg/1			Mass in Thousand Lbs/Day		
			1960-1961			1960-1961			1960-1961			1960-1961			1960-1961	
		'52-'56 cfs	cfs	% of '52-'56	'52-'56 Mg/1	Mg/1	% of '52-'56	'52-'56 M Lbs/D	M Lbs/D	% of '52-'56	'52-'56 Mg/1	Mg/1	% of '52-'56	'52-'56 M Lbs/D	M Lbs/D	% of '52-'56
(N. Fork Holston River)																
Above Saltville, Va.	NH- 81.1	261	171	65	101	127	126	113	101	89	2	7	350	2.4	4	167
Below Olin Mathieson	NH- 73.1	261	293	112	2,694	2,375	88	1,708	1,550	91	2,986	2,527	85	1,843	1,649	89
Holston, Virginia	NH- 58.1	465	-	-	1,825	-	-	1,820	-	-	2,005	-	-	1,845	-	-
Gate City, Virginia	NH- 8.8	781	1,243	159	1,240	-	-	1,989	-	-	1,070	804	75	1,849	1,967	106
(S. Fork Holston River)																
At Kingsport Waterworks	SH- 6.0	2,150	2,290			100			1,210			—	—		—	—
At Mouth	SH- 0.5	2,150			108			1,395			9	—	—	96	—	-
(Holston River)																
Below Confl.N&S.Forks	H-137.9	2,950	-	-	216	-	-	3,384	-	-	133	-	-	1,945	-	-
Rogersville, Tenn.	H-104.2	3,370			210			3,811			107			1,950		
(John Sevier Steam Plant)	H-106.5		3,114	93		223	106		3,603	95		114	107		1,970	101
Morristown, Tenn.	H- 75.2	3,750	-	-	207	-	-	-	-	-	96	-	-	-	-	-
At N.E. Knox Utility	H- 9.5		4,477	109		162	79		3,902	86		58	66		1,578	81
At Mouth (Ruggles Ferry)	H- 5.5	4,120			204			4,537			88			1,958		
(French Broad River)																
At Mouth (Riverdale Ferry)	FB- 7.5	6,120			47			1,550			7			232		
At Knox. Chapman Utility	FB- 3.9		7,302	119		52	111		1,915	123		8	114		305	131
(Tennessee River)																
At Knoxville, Tenn.	T-649.2	10,240	13,595	133	106	98	92	6,087	7,164	118	39	33	85	2,190	2,537	116

SUMMARY OF RECENT DATA
ON THE HOLSTON RIVER SYSTEM

DISCHARGE, HARDNESS AND CHLORIDES

For the Average of the Last Three Water Years
1958-1959; 1959-1960; and 1960-1961

TABLE 2

SAMPLE STATION LOCATION	RIVER MILE	DISCHARGE IN CFS			HARDNESS AS CaCO 3						CHLORIDES as Cl					
			AVG.3 WATER YRS 1958-1961		Concentration in Mg/1			Mass in Thousand Lbs/D			Concentration in Mg/1			Mass in Thousand Lbs/D		
		'52-'56			'52-'56	AVG.3 WATER YRS 1958-1961		'52-'56	AVG.3 WATER YRS 1958-1961		'52-'56	AVG.3 WATER YRS 1958-1961		'52-'56	AVG.3 WATER YRS 1958-1961	
		cfs	* cfs	% of '52-'56	mg/1	mg/1	% of '52-'56	M Lbs/D	M Lbs/D	% of '52-56	mg/1	mg/1 M Lbs/D	% of '52-56	M Lbs/D	M Lbs/D	% of '52-'56
N. Fork Holston River																
Above Saltville, Va.**	NH-81.1	261	181	69	101	113	112	113	79	70	2	5	250	2.4	3	125
Below Olin Mathieson	NH-78.1	261	263	101	2694	2379	88	1708	1517	89	2986	2531	85	1843	1614	88
Holston, Virginia	NH-58.1	465	-	-	1825	-	-	1820	-	-	2005	-	-	1849	-	-
Gate City, Virginia	NH- 8.8	781	769	98	1240	1177	95	1989	2087	105	1070	1025	96	1849	1656	91
S. Fork Holston River																
At Kingsport Waterworks	SH-6.0	2150	2511	117		83	-		2089	-	-	-	-	-	-	-
At Mouth	SH-0.5	2150			108			1395	1460	105	9			96		
Holston River																
Below Confl. N&S Forks	H-137.9	2930			216			3384			133			1945		
Rogersville, Tenn.	H-104.2	3370			210			3811			107			1950		
(John Sevier Steam Plant)	H-106.5		3219	96		207	92		3434	90		102	95		1649	84
Morristown, Tenn.	H- 75.2	3750	-	-	207	-	-	-	-	-	-	-	-	96	-	-
At N.E. Knox. Utility	H- 9.5															
At Mouth(Ruggles Ferry)	H- 5.5	4120	-	-	204	-	-	4537	-	-	88	-	-	1958	-	-
French Broad River																
At Mouth (Riverdale Ferry)	FB- 7.5	6120	-	-	47	-	-	1550	-		7	-	-	232	-	-
At Knox. Chapman Utility	FB- 3.9															
Tennessee River																
At Knoxville, Tenn.	T-649.2	10240	-	-	106	-	-	6087	-	-	39	-	-	2190	-	-

Note: Underlined Values Are For The Last 3 Water Years Ending September 1961. (Except NH-81.1 Which Includes Only Last 2 Water Years).
* 1958-1961 Discharge Represents The Average of The Discharge Rates Observed Only On The Sampling Days.
** Average of 2 Water Years (1959-60 and 1960-61).

SUMMARY OF RECENT DATA ON THE HOLSTON RIVER SYSTEM

DISCHARGE

Comparing Average of Discharge Rates Recorded Only
on Sampling Days; with Averages for Every Day in the Year

TABLE 3

SAMPLE STATION Location	River Mile	AVG. During '52-'56	OCT.'58-SEPT.'59 WATER YEAR				OCT.'59-SEPT.'60 WATER YEAR				OCT.'60-SEPT.'61 WATER YEAR				AVG. LAST 3 WATER YEARS			
			AVG.During Entire Water Year		AVG.ofDisch. During Samplg.Days		AVG.During Entire Water Year		AVG.ofDisch. During Samplg.Days		AVG. During Entire Water Year		AVG.ofDisch. During Samplg.Days		AVG.During Entire 3 Water Yrs.58-61		AVG.ofDisch. During Samplg.Days	
		* cfs	cfs	%of52-56	cfs	%of52-56	cfs	%of52-56	cfs	%of52-56	cfs	%of52-56	cfs	%of52-56	cfs	%of52-56	cfs	%of52-56
N. Fork Holston River																		
Above Saltville, Va.	NH-81.1	261	200	77	-	-	297	114	192	73	289	111	171	65	262	100	181	69
***Below Olin Mathieson	NH-78.1	261	200	77	200	76	297	114	297	114	289	111	293	112	262	100	263	101
Holston, Virginia	NH-58.1	465	376	79	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gate City, Virginia	NH- 8.8	781	623	81	357	46	891	114	1208	155	873	112	1243	159	796	102	769	98
S. Fork Holston River																		
At Mouth	SH- 0.5	2150											-	-				
At Kingsport	SH- 3.8		2425	113			2817	131			2290	106			2511	117		
Holston River																		
Below Confl. N&S Forks	H-137.9	2930											-	-				
Surgoinsville	H-118.8		3077	105			3928	134			3278	112			3428	117		
Rogersville, Tenn.	H-104.2	3370	3249	96			4148	123			3462	103			3620	107		
**(John Sevier Stm.Plt.)	H-106.5				2921	87			3656	108			3114	93			3219	96
Morristown, Tenn.	H- 75.2	3750																
Jefferson City (Cherokee Dam)	H- 52	3750	3628	97	-	-	4455	119	-	-	4313	115	-	-	4132	110	-	-
At N.E. Knox Utility	H- 9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
At Mouth(Ruggles Ferry)	H- 5.5	4120	3880	94	-	-	4748	115	-	-	4477	109	4477	109	4368	106	-	-
French Broad River																		
At Mouth(Riv'dale Fry.	FB- 7.5	6120	6069	99	-	-	9219	150	-	-	7302	119	7302	119	7530	123	-	-
At Knox.Chapman Util'y.	FB- 3.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tennessee River																		
At Knoxville, Tenn.	T-649.2	10240	11160	109	-	-	15430	151	-	-	13595	133	13595	133	13395	131	-	-

* Data from the September 1960 "Report on Pollution of Interstate Waters of the North Fork Holston River and of the Holston and Tennessee Rivers; Virginia-Tennessee."

** Q @ John Sevier Steam Plant Location = 1.056 x Q @ Surgoinsville.

*** Discharge Assumed to be approximately equal discharge as gaged above Saltville.

NORTH FORK OF THE HOLSTON RIVER

Above Saltville, Virginia, at River Mile NH-81.1.

Hardness concentration of the natural river water above Saltville, during the last three water years, was slightly higher than the 1952-1956 average (101 to 113 mg/l = 12% increase).

The total mass, expressed as pounds of hardness per day, however, was less than the 1952-1956 average (113,000 to 79,000 lbs/day = 30% reduction). This lower total mass, contained in slightly harder water, reflects the lower average of river discharge rates during the days samples were collected over the past three water year (261 to 181 cfs = 31% reduction).

During the last water year of 1960-1961 the hardness above Saltville exceeded the average of the last three water years. During this last year, the concentration of hardness was significantly higher, and the total mass somewhat lower than the average for the 1952-1956 period. The river discharge was also lower during 1960-1961. Comparison of the 1960-1961 averages with the 1952-1956 data of the "1960 Report" are as follows:

(261 to 171 cfs = 35% flow reduction)
(101 to 127 mg/l =26% concentration increase)
(113,000 to 101,000 lbs/day = 11% mass reduction)

Both the concentration and mass of chlorides in the natural waters above Saltville increased significantly over the last three water years. The 1960-1961 chloride content also exceeded the average of the last three water years. The increases over the 1952-1956 averages are as follows:

Last three water years 1958-1961

(2 to 5 mg/l = 150% concentration increase)
(2,400 to 3,000 lbs/day = 25% mass increase)

Last Water Year 1960-1961

(2 to 7 mg/l = 250% concentration increase)
(2,400 to 4,000 lbs/day = 67% mass increase)

The actual magnitude of these particular increases, however, are relatively insignificant. For example, the 1,600 pounds per day chloride increase shown in the 1960-1961 data is only 0.1 per cent of the 1,649,000 pounds per day mass of chlorides below Olin Mathieson. Such water quality variations above Saltville do not, therefore, exert any appreciable influence on present quality of the river below Olin Mathieson.

Below Olin Mathieson at River Mile NH-78.1

This sampling station is located below the point where Olin Mathieson waste equalizing lagoons discharge to the River. Olin Mathieson collects and analyzes daily samples at this station. The 1958-1961 and the 1960-1961 summaries presented in this report supplement are based on these laboratory reports submitted to the Virginia Water Control Board by Olin Mathieson. The U.S.G.S. river discharge records, for the Saltville gaging station located at River Mile NH-81.5, were used directly for flow and mass calculations.

This procedure differs from the indirect calculation method followed during preparation of the "1960 Report." The 1952-1956 summaries presented in the "1960 Report" were interpolated from U.S.G.S. flow and water quality records from the station above Saltville, Virginia, (River Mile NH-81.1) and the one at Holston, Virginia, (River Mile NH-58.1). Although the calculation methods differ, the results are comparable and permit the following evaluation of this stream section over the three periods of record:

During the last three water years, the hardness of this river water containing the Olin Mathieson wastes was 11 per cent to 12 per cent lower than the 1952-1956 average. The average of river discharges during this period almost equalled the 1952-1956 average.

(261 to 263 cfs = 1% flow increase)
(2,694 to 2,379 mg/l = 12% concentration reduction)
(1,708,000 to 1,517,000 lbs/day = 11% mass reduction)

During the last water year the hardness record was approximately equal to the average of the last three water years. Comparison of the 1960-1961 record with the 1952-1956 average is as follows:

(261 to 293 cfs = 12% flow increase)
(2,694 to 2,375 mg/l = 12% concentration reduction)
(1,708,000 to 1,550,000 lbs/day = 9% mass reduction)

The change in chlorides paralleled hardness variation between the three periods of record. This reduction below the 1952-1956 averages ranged from 11 per cent to 15 per cent as follows:

Last Three Water Years 1958-1961

(2,986 to 2,531 mg/l = 15% concentration reduction)
(1,843,000 to 1,614,000 lbs/day = 12% mass reduction)

Last Water Year 1960-1961

(2,986 to 2,527 mg/l = 15% concentration reduction)
(1,843,000 to 1,649,000 lbs/day = 11% mass reduction)

An approximation of the hardness and chloride loads, discharged to the river by Olin Mathieson, can be obtained by subtracting the "above Saltville" values from the averages "below Olin Mathieson". A comparison of these loads during the three record periods is shown below:

Hardness	Thousand lbs/day
1952-56	1,708 - 113 = 1,595
1958-61	1,517 - 79 = 1,438 = 90% of 1952-56
1960-61	1,550 - 101 = 1,449 = 91% of 1952-56

Chlorides	Thousand lbs/day
1952-56	1,843 - 2.4 = 1,840
1958-61	1,614 - 3.0 = 1,611 = 88% of 1952-56
1960-61	1,649 - 4.0 = 1,645 = 90% of 1952-56

These data indicate that, on the average, 1,440,000 pounds per day of hardness and 1,630,000 pounds per day of chlorides are presently discharged to the river by Olin Mathieson. These loads are approximately 11 per cent less than the average loading during the 1952-1956 period.

The trend of river water quality below Olin Mathieson is posted in Table 4 and shown graphically on Figure V. This trend, expressed in terms of hardness, varies with the chemical pollution load discharged from the Olin Mathieson waste equalizing lagoon.

The curve shows that river water hardness has been reduced from 2,510,000 pounds per day in 1947 to 1,531,000 pounds per day in 1952. After rising to an intermediate peak of 2,219,000 pounds per day in 1954, the hardness continued to fall to the 1,404,000 pounds per day average for 1955.

From 1955 to the present, however, the trend has leveled off and shows a slight reversal during the last six years. After reaching an intermediate low of 1,255,000 pounds per day in 1958, the average annual hardness again increased to 1,550,000 pounds per day for the most recent 1960-1961 water year.

Although the present hardness is less than the average of the entire 1952-1956 period, it remains almost identical with the hardness level experienced during four of those past five years. Figure V shows that the 1,708,000 pounds per day average for 1952-1956 is significantly influenced by the disproportionately high 2,219,000 average experienced during the single 1954 calendar year. During the other four of these five years, the hardness averaged out to 1,531,000 pounds per day. The curve reveals how closely this value corresponds with the 1960-1961 value of 1,550,000 and the 1,517,000 average for the last three water years.

TABLE 4

NORTH FORK OF THE HOLSTON RIVER
Below Olin Mathieson

HARDNESS

Annual Averages Expressed As
% of the 1952-1956 5-Year Averages
And the 1952, 1953, 1955, & 1956 4-Year Average

PERIOD	HARDNESS as Ca CO_3 M LBS./DAY	% of 1952-56 AVERAGES		
		BASED ON "1960 REPORT"	BASED ON AVG. of O.M. DATA	
			ENTIRE 5 YEARS	4 YEARS EXCLUDING 1954
1)	2)	3)	4)	5)
1947	2510	150	147	164
1948	2604	156	152	170
1949	1845	111	108	120
1950	2608	156	153	170
1951	2074	124	121	135
1952	1531	92	90	100
1953	1688	101	99	110
1954	2219	133	130	145
1955	1404	84	82	92
1956	1500	90	88	98
1957	1521	91	89	99
1958	1255	75	74	82
1959	1631	98	96	106
1960	1372	82	80	90
1958-59 Water Year	1391	83	82	91
1959-60 " "	1609	96	94	105
1960-61 " "	1550	93	91	101
AVG. 1958-61 W.Y.'s	1517	91	89	99

---

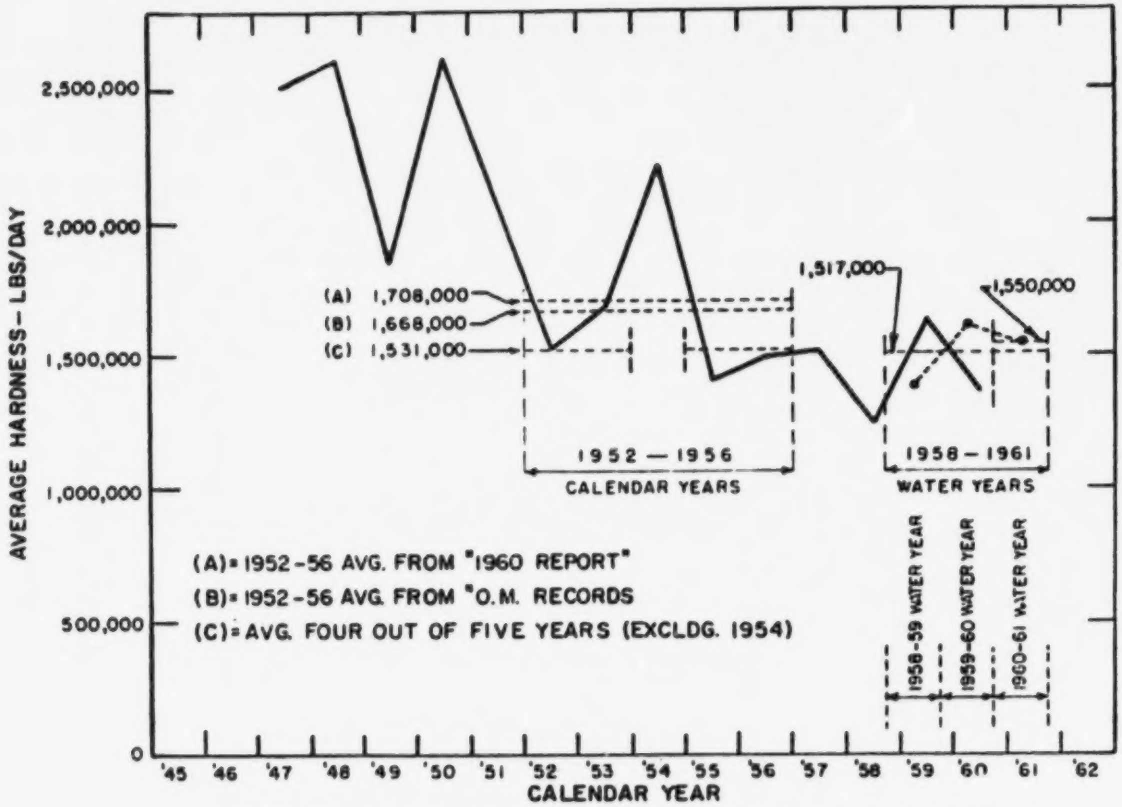
1) The first 14 periods are based on Calendar Years (Jan. 1 - Dec. 31). The last 4 periods are based on Water Years (Oct. 1 - Sept. 30).

2) Hardness as $CaCO_3$ calculated from Olin Mathieson's reports of "$CaCl_2$ to River." Annual Average of 365 Daily Grab Samples. Hardness as $CaCO_3 = CaCl_2 \times 100/111$.

3) 1952-1956 Avg. Hardness from "1960 Report" = 1708 M Lbs./Day. (Obtained by interpolation of USGS flow and water quality records at points above and below O.M. Sampling Station).

4) 1952-1956 Avg. Hardness from O.M. Reports = 1668 M Lbs./Day.

5) Avg. Hardness during 1952, 1953, 1955 and 1956 = 1531 M Lbs./Day. (Excluding the 1954 load which deviated from the mean of the other 4 years).



NORTH FORK OF HOLSTON RIVER BELOW OLIN MATHIESON HARDNESS CALCULATED FROM U.S.G.S. FLOW DATA AND OLIN MATHIESON CACI$_3$ RECORDS

FIGURE V

Near Gate City, Virginia, at River Mile NH-8.8

During the past three water years Olin Mathieson has collected samples of the North Fork of the Holston River near Gate City at approximately monthly intervals. Hardness and chloride determinations were made on these samples by the Virginia State Water Control Board Laboratory. Hardness tests were discontinued in February 1959. The average values for data collected over the recent three-year period are consistent with other related information and confirm the 1952-56 data of the 1960 report.

The single year average for the 1960-61 water year, however, does not conform to the general pattern of other associated factual data. For instance, the total mass of chlorides averages out to 1,967,000 pounds per day whereas, the average below Olin Mathieson is but 1,469,000 pounds per day. This difference of approximately 300,000 pounds per day, greatly exceeds the normal 5,000 - 6,000 pounds per day chloride load that can logically be expected from the intervening tributary streams. It should also be noted that the average river discharge at this point during the sampling days was 159 per cent of the 1952-56 average discharge. This is severely out of line with other discharge figures which varied only 10± per cent from the 1952-56 data. Furthermore, this discharge of 1,243 cfs is 142 per cent of the 873 cfs annual average discharge for the entire water year as recorded by U.S.G.S. Therefore, average of the twelve samples collected at Gate City during the 1960-61 water year cannot be considered typical of the entire water year.

In general, present condition of the North Fork of the Holston River, near the mouth at Gate City, approximates the average which prevailed during the 1952-56 period. The river contains about 2,000,000 pounds per day of hardness at approximately 1,200 mg/l concentration. The chloride content is slightly less, or about 1,660,000 pounds per day at 1,000 mg/l concentration.

SOUTH FORK OF THE HOLSTON RIVER

River Mile SH-1.2 and at the Kingsport, Tennessee Water Works Intake at River Mile SH-6.0.

The tabulated summaries of Table 18 are based on the Kingsport Water Works daily analysis of raw water hardness. Total pounds of hardness are computed from U. S. Geological Survey flow data from the gate at River Mile SH-3.8. The mean hardness concentration was 83 mg/l for the 1958-1961 water years and 100 mg/l for the 1960-1961 water year. The mean hardness load for the same water years was 1,089,000 pounds per day and 1,210,000 pounds per day.

The Kingsport industries below the water plant at SH-6.0 contribute to the hardness of the South Fork. Since no recent long-term daily analysis of hardness at the mouth of the South Fork is available, an approximation was necessary. From August 26 to August 29, 1960, T.V.A. had simultaneously sampled a series of 6-hour, 5-point composites at SH-4.7 and SH-1.2. The increase in hardness between these locations was assumed to be contributed by Kingsport industries and tributaries. The mean increase was computed as 371,000 pounds per day. The sum of the hardness load at the Kingsport Water Works and 371,000 pounds per day is assumed to be the hardness contribution of the South Fork to the Holston River. For the 1958-1961 water years, the South Fork contribution is computed as being 1,460,000 pounds per day, which compares favorably to the 1952-1956 mean of 1,395,000 pounds per day.

HOLSTON RIVER

At John Sevier Steam Plant at River Mile H-106.5

The steam plant is located near Rogersville, Tennessee at Holston River Mile H-106.5. The nearest U.S.G.S. flow gage is located near the Surgoinsville, Tennessee bridge at Holston River Mile H-118.8.

Holston River water samples were collected at the inlet to the John Sevier Steam Plant by plant personnel. Samples were analyzed for conductivity (Mmhos), hardness (ppm $CaCO_3$) and chlorides (ppm NaCl), by the Steam-Electric Generation Branch of T.V.A.

U.S.G.S. discharge records for the Holston River at Surgoinsville, Tennessee were used to compute the discharge at the John Sevier Steam Plant location. The drainage area above Surgoinsville is 2,874 square miles. That above the steam plant is approximately 3,035 square miles. The most probable discharge at the steam plant was therefore proportioned according to the relative drainage areas above the two reference points, i.e. "Q" at John Sevier Plant = 3035/2874 = 1.056 x recorded discharge of the Holston River at Surgoinsville.

Chlorides were reported by T.V.A. as NaCl. This data was converted to chlorides as Cl to make the summaries consistent with the units of measure used at other stations, i.e. chlorides as NaCl x 0.607 = chlorides as Cl.

Monthly and annual averages, and the maximum and minimum records, shown in the tables were developed from a series of 50 separate samples collected during each of the three water years from October 1958 to September 1961.

During the last three water years the hardness varied widely from 20 to 520 mg/l. Recent averages again confirmed the 1952-1956 data of the "1960 report". The average of the last three water years was 207 mg/l, as compared with 210 for the 1952-1956 period. The computed mass during 1958-1961 was 3,434,000 pounds per day, or about 10 per cent less than the 3,811,000 1952-1956 average.

Chloride concentrations of 114 for 1960-1961 and 102 for the past three water years also approximated the 107 mg/l 1952-1956 average. The 1958-1961 mass of chlorides averaged 1,649,000, or 16 per cent less than the 1,950,000 pounds per day average for 1952-1956. Chlorides increased again during 1960-1961, and the annual average of 1,970,000 pounds per day was almost identical to the 1952-1956 average.

Since the chemical content again increased during the 1960-1961 water year, it appears that present water quality at this location approximates that which prevailed during the 1952-1956 period.

Cherokee Lake, at Morristown, Tenn. at River Mile H-75.2

During certain seasons of the year the Holston River Water, flowing through Cherokee Lake, is used as a source of domestic water supply by the Morristown, Tennessee Water System. The water department determines raw water hardness and chlorides about twice a week but Holston River water analyses were discontinued from February 21 to June 2, 1961.

Although data for nine months cannot be compared directly with averages over a full water year, the average of the 64 samples during this period are shown below:

Hardness varied from 136 to 436 and averaged 204 mg/l. This value agrees with the 1952-1956 average concentration of 207 mg/l.

Chlorides ranged from 10 to 248 with an average of 62 mg/l. This nine-month average is approximately two-thirds of the 96 mg/l five-year average during 1952-1956.

At North East Knox Utility Water Works Intake at River Mile H-9.5

During the 1960-1961 water year daily samples of river water were collected at the North East Knox Utility water works. Hardness and chloride determinations were made by the Knoxville Utility District. The raw water intake is located on the bank of the Holston River at Mile H-9.5. River discharge records, from the gaging station at River Mile 5.5 were obtained from the U.S.G.S.

The average discharge rates have increased slightly during recent years. The mean annual discharge rate was 4,368 cfs for the 1958-61 period and 4,477 cfs for the most recent 1960-61 water year. These rates are 6 per cent and 9 per cent respectively greater than the 1952-1956 average of 4,120 cfs.

The chemical concentration in the river water at this point is decidedly lower than the 1952-1956 averages. The 162 mg/l 1960-61 hardness is but 79 per cent of the 204 mg/l 1952-56 average. The average chloride concentration was 58 mg/l, or 66 per cent of the 88 mg/l 1952-56 average.

Furthermore, the computed mass of hardness and chlorides is significantly lower than values projected from other established trends. The 3,902,000 pounds per day of hardness is 88 per cent of the 4,537,000 pounds per day during 1952-1956. Similarly, the 1,578,000 pounds per day chloride content is but 81 per cent of the 1,958,000 1952-56 average.

Because of the distinct divergence from the trend, this particular set of data does not appear representative of the average cross-section of the Holston River at this location, especially since the computed total chloride mass of 1,578,000 pounds per day at this point is less than the 1,649,000 value just below Olin Mathieson and 1,970,000 upstream at John Sevier Steam Plant.

It was not possible to establish a mass balance between the sum of chlorides in the Holston and French Broad Rivers with the mass in the Tennessee River just below the junction:

Mouth of Holston River	1,578,000 lbs/day
Mouth of French Broad River	305,000
Sum at Confluence	1,883,000
Tennessee River below Confluence	2,537,000

These data from Holston River Mile H-9.5 are included in the summaries to provide a complete report of related information obtained during the 1960-1961 water year. It must be viewed and used with caution, however, until the conditions portrayed by it are substantiated or modified by additional factual information.

FRENCH BROAD RIVER

At Knox-Chapman Utility Water Works Intake at River Mile FB-3.9

This 1960-1961 summary is based on daily water samples collected at the Knox-Chapman Utility Water Treatment Plant. The laboratory determinations were made by the Knoxville Utility District. The raw water intake is located on the bank of the French Broad River at Mile FB-3.9. The U.S.G.S. discharge records are from the gaging station at Mile FB-7.4.

Hardness and chloride concentrations are moderately higher than the 1952-1956 averages. Hardness has increased 11 per cent from 47 to 52 mg/l. Chlorides increased 14 per cent from 7 to 8 mg/l. This is accompanied by a 19 per cent increase in river discharge from 6,120 to 7,302 cfs.

Accumulation of these higher flows and concentrations increased the mass of hardness and chlorides in the French Broad River by 23 per cent and 31 per cent respectively. The average hardness increased from 1,550,000 to 1,915,000 pounds per day and chlorides from 232,000 to 305,000 pounds per day.

TENNESSEE RIVER

At Knoxville Utility Water Works Intake at River Mile T-649.2

This summary of 1960-61 data is computed from daily hardness and chloride analyses of raw river water provided by the Knoxville Utility District. The quality represents the condition of the Tennessee River at their submerged raw water intake. Flow data is obtained from the U.S.G.S. records from their gaging station at River Mile T-651.4.

The concentrations of hardness and chlorides shown in the 1960 report are also based on the Knoxville raw water analyses. The flow, however, represents the sum of the discharges at mouths of the Holston and the French Broad Rivers. The 1952-56 total masses of hardness and chlorides at Knoxville, Tennessee were obtained by direct summation of all upstream sources of these loads.

The 13,592 cfs 1960-61 average flow of the Tennessee River is 33 per cent greater than the 10,240 cfs summated average shown for the 1952-1956 period. Thus, although 1960-61 concentrations were lower, the actual mass of hardness and chlorides flowing past the Knoxville water intake was distinctly higher than the 1952-1956 calculated average.

The hardness concentration has changed from 106 mg/l during 1952-1956 to 98 mg/l for 1960-61 and the chlorides from 39 mg/l to 33 mg/l. These reductions were 8 per cent and 15 per cent respectively. An appreciable part of this difference is due to the increased proportional flow of the more dilute French Broad River water.

The mass of hardness increased 18 per cent from 6,087,000 to 7,164,000 pounds per day. Chlorides increased 16 per cent from 2,190,000 to 2,537,000 pounds per day. If there is thorough mixing of the water from the two tributaries, approximately 5 per cent of the hardness and 3 per cent of the chloride can be attributed to the increased mass in the French Broad River.

Here again, further studies including analyses of water throughout the entire cross-section of the river are desirable. Such a study would indicate whether or not there is stratification of Holston and French Broad River waters in the Tennessee River at this sampling station. It would also show if the quality of raw water at the Knoxville Utility water treatment plant is representative of the average quality of all Tennessee River water flowing through this cross-section.

PER CENT OF HARDNESS AND CHLORIDES ATTRIBUTABLE TO OLIN MATHIESON WASTE DISCHARGES

Table 5 shows the calculated percentage of hardness and chlorides, at key points in the River System, attributable to Olin Mathieson waste discharges during the three periods of record.

At Gate City, approximately 68 per cent of the hardness and 97 per cent of the chlorides in the North Fork of the Holston River come from the Olin Mathieson waste discharges. The limited number of recent samples, and accompanying scatter of current data are described elsewhere in this report. Therefore no accurate comparison can be made between the three periods of record.

The hardness values for the Holston River at the John Sevier Steam Plant location, just above Cherokee Lake, are exceptionally consistent from period to period. Here, 42 per cent of the total hardness load is due to the Olin Mathieson wastes. Chlorides varied more; showing 98 per cent for the last three years and 84 per cent for the last year as compared with 95 per cent for the 1952-1956 period.

At the mouth of the Holston River, near Knoxville, the data were inconsistent with other trends. An average of the hardness data shows a present percentage of 27 compared with 35 for the 1952-1956 period. The 105 per cent figure for chlorides is of course not valid.

These percentages were lowered significantly in the Tennessee River at Knoxville. The 1960-61 water years data indicated that 20 per cent of the hardness and 65 per cent of the chlorides were attributable to Olin Mathieson waste discharges, as compared with 26 per cent and 84 per cent respectively for the 1952-1956 period.

As discussed in other sections, this change is partially due to the increased flow and chemical content of the French Broad River. These values can also vary with the extent to which Holston River and French Broad River waters are mixed before reaching this sampling station.

Further refinement of this data would require additional studies. Such studies should also include investigation of stratification and/or

TABLE 5

CALCULATED PERCENTAGES OF HARDNESS AND CHLORIDES ATTRIBUTABLE TO OLIN MATHIESON WASTE DISCHARGES

"1960 Report" Data for 1952-1956
Compared With
Most Recent Data Collected During the
1958-1959; 1959-1960 and 1960-1961 Water Years

RECENT RECORD	HARDNESS			CHLORIDES		
	Total Lbs./Day	% From O.M.		Total Lbs./Day	% From O.M.	
		Recent Data	1952-1956		Recent Data	1952-1956
3 Year Period (1958-1961)						
Below O.M.	1,517,000	95	93.5	1,614,000	100-	99.8
Above O.M.	79,000	-	-	3,000	-	-
From O.M.	1,438,000	100	100	1,611,000	100	100
At Gate City	2,087,000	68.2	80.2	1,656,000	97.3	99.6
At John Sevier	3,434,000	41.6	41.8	1,649,000	97.8	94.5
1 Year Period (1960-1961)						
Below O.M.	1,550,000	93.4	93.5	1,649,000	100-	99.8
Above O.M.	101,000	-	-	4,000	-	-
From O.M.	1,449,000	100	100	1,645,000	100	100
At Gate City	-	-	80.2	1,967,000	83.7	99.6
At John Sevier	3,603,000	40.2	41.8	1,970,000	83.5	94.5
Holston at Mouth	3,902,000	27.1	35.2	1,578,000	(105.0)	94.1
Tenn. At Knoxville	7,164,000	20.2	26.2	2,537,000	65.0	84.0

mixing of the tributary waters at the head of the Tennessee River.

EFFECT OF RIVER DISCHARGE ON HARDNESS AND CHLORIDES

Water quality of the Holston River System is also influenced by precipitation, runoff and river discharge. Variations in these phenomena alter the natural chemical content of tributary waters and adjust the concentration level of pollutants in the main streams. The significance of year to year discharge variations must therefore be considered in appraisals of pollution loads and resultant river quality.

Figures VI and VII illustrate this influence on tributary streams. They show how the concentration and total pounds of natural hardness and chlorides vary according to discharge in the North Fork Holston River above Saltville.

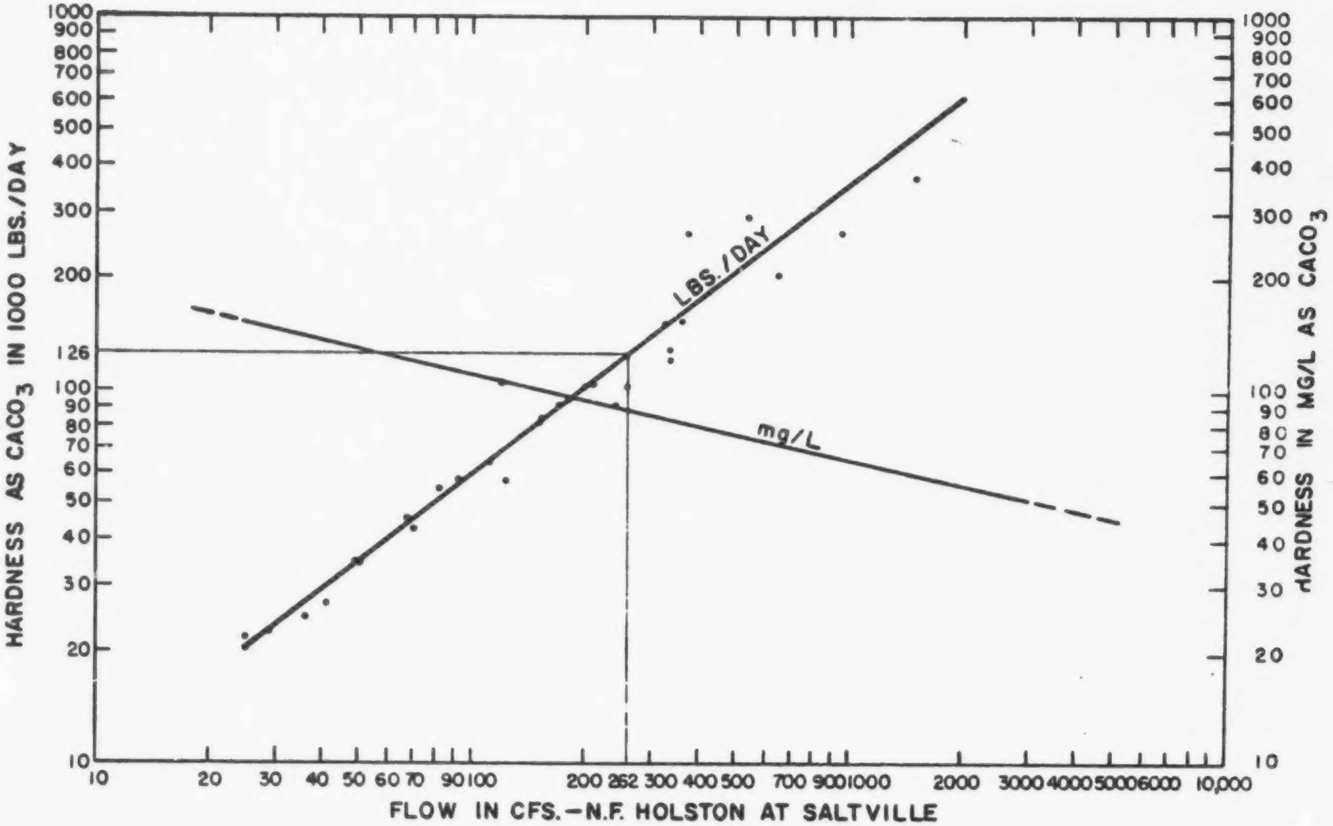
For example; at 262 cfs mean annual discharge, these waters contained 126,000 pounds per day of hardness at a concentration of 89 mg/l. During minimum flows of 25 cfs, the total hardness content fell to 20,500 pounds per day but the concentration in the stream rose 71 per cent to 152 mg/l. Conversely, during 5,500 cfs maximum discharge, the total 1,340,000 pounds per day of hardness were diluted down to only 45 mg/l.

Accordingly, the concentration of hardness and chlorides in the streams will normally decline during years of increased discharge. This trend will prevail if there is no extraneous pollution, or if the extraneous loading remains constant during varying river discharges.

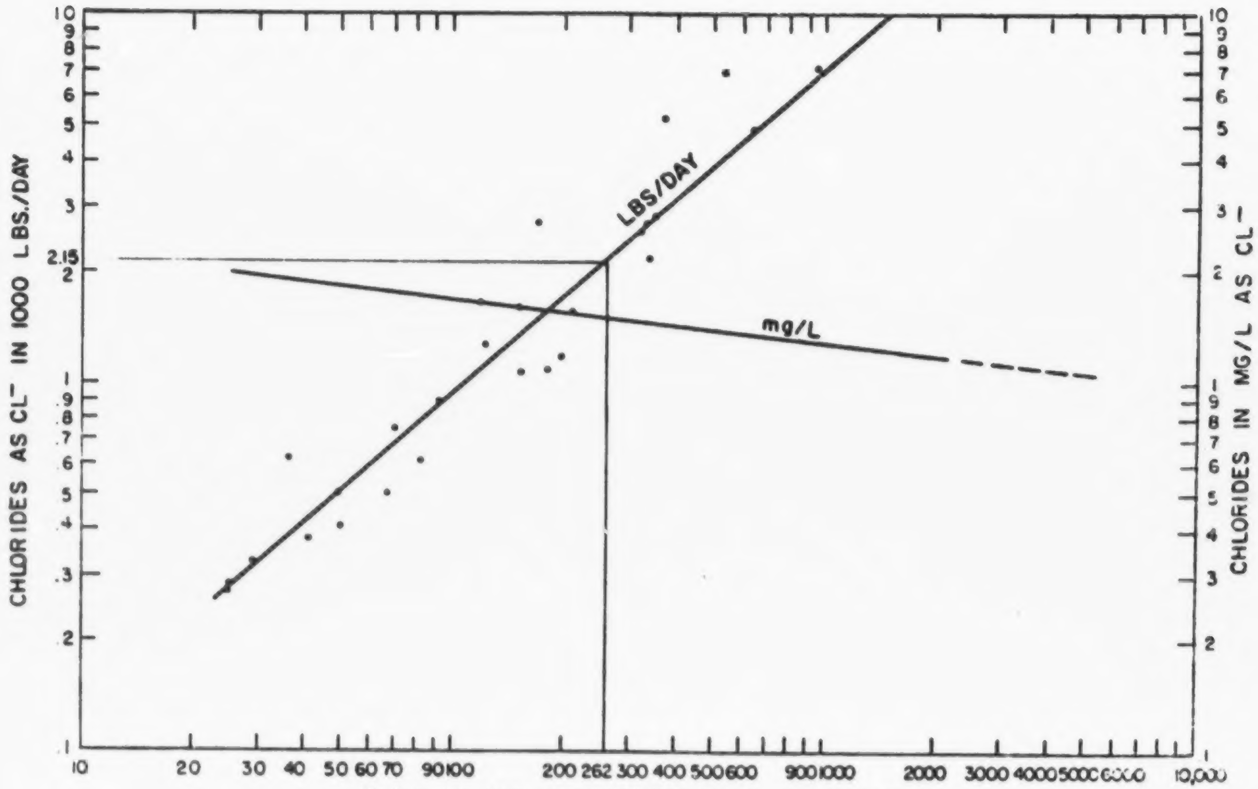
Obviously, the quality of river water is dependent upon both river discharge and pollutional loading. The degree to which each of these variables affect quality, however, depends upon the ratio of hardness (and chlorides) in the polluted main stream and in the diluting tributary flow.

Immediately below a large pollutional load, changes in these two variables have a direct and almost equal effect. For example, the hardness concentration of the North Fork Holston River below the Olin Mathieson plant will be reduced approximately 9 per cent by either a 10 per cent reduction in waste loading or a 10 per cent increase in river discharge.

These effects are less pronounced in the more distant downstream reaches where the normal river flow has been greatly increased by tributary stream flow. At these downstream locations, year to year changes in mean river discharges or upstream pollutional loads no longer have the same relative effect on hardness concentrations.



HARDNESS VS. FLOW, NORTH FORK HOLSTON RIVER
ABOVE SALTVILLE
FIGURE VI



CHLORIDES VS. FLOW, NORTH FORK HOLSTON RIVER
ABOVE SALTVILLE
FIGURE VII

For example, a 2 per cent reduction in the hardness concentration of the Tennessee River at Knoxville, Tennessee would normally accompany a 10 per cent reduction in pollutional loading from the Olin Mathieson plant in Saltville, Virginia. But without any change in upstream pollutional loading, the Tennessee River hardness concentration would be reduced 4 per cent by a 10 per cent increase in river discharge.

During the last three water years, from 1958 through 1961, the discharge of the North Fork Holston River approximated the 1952-56 mean discharge. During this recent period the 796 cfs flow at Gate City was 102 per cent of the 781 cfs mean discharge during 1952-56 and 92 per cent of the 854 cfs average discharge during the past thirty years of record. Therefore, changes in hardness and chloride concentrations between the 1952-56 and the 1958-61 periods can be attributed to changes in pollutional loadings.

As shown in Table No. 3, the South Fork Holston River discharge increased 17 per cent and the Holston River discharge increased from 6 per cent to 10 per cent during these same two periods. Reductions of hardness and chloride concentrations in the Holston River are partially responsive to this increased dilution.

The 13,395 cfs 1958-61 mean discharge record for the Tennessee River at Knoxville, Tennessee is 31 per cent above the 10,240 average for 1952-56 and 5 per cent above the 12,810 cfs average discharge over the last 61 years of record. A large part of this increased Tennessee River flow stemmed from a 23 per cent increase in the tributary flow from the relatively soft French Broad River. Therefore, increased river discharge, rather than reduced pollutional loading, was primarily responsible for the reduced hardness and chloride concentrations in the Tennessee River at Knoxville, Tennessee.

PART III

APPENDIXES

APPENDIX A

AVERAGES OF CURRENT DATA

EXPLANATORY NOTES FOR APPENDIX A

1. Discharge records represent the mean daily rate of flow in cfs for only the day, or days, when stream samples were collected. These specific discharge summaries, therefore, cannot be compared directly with U.S.G.S. tabulations based on 365 records per year.

2. Whenever more than one sample was collected per month, the tabulated values represent the average of all data collected during sampling days in the calendar month.

3. Concentration of Hardness and Chlorides in mg/1 (Columns 3 and 5):

   Each posted monthly value represents the arithmetic average of all determinations made during that month.

   The posted AVG. value is the arithmetic average of all determinations made during that water year. If more than 12 samples were collected during this year, the AVG. value will not necessarily equal a straight average of the 12 monthly values posted in the tables. Similarly, maximum and minimum values cover all samples for the year; not necessarily values shown in the monthly postings.

4. Mass of Hardness and Chlorides in M#/Day (Columns 4 and 6):

   Values posted in these columns are in effect weighted averages. On each sampling day, mass was computed from the measured concentration of the sample and the mean daily discharge for that day.

   Here again, AVG. maximum and minimum values cover all samples for the year; not necessarily values shown in the monthly postings.

TABLE 6

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-81.1; Above Saltville

DISCHARGE, HARDNESS & CHLORIDES
Average for the Last Two Water Years

"1960 Report" Data for 1952-1956

Compared With:

Most Recent Data Collected During The
1959-1960; & 1960-1961 Water Years

	PERIOD	DISCHARGE		HARDNESS as $CaCO_3$				CHLORIDES as Cl			
		cfs	% of '52-'56	mg/l	% of '52-'56	M#/Day	% of '52-56	mg/l	% of '52-'56	M#/Day	% of '52-'56
1960 Report Data	1952-56	261	-	101	-	113	-	2	-	2.4	-
Annual Average	1959-60	192	73%	98	97%	54	48%	4	200%	2	83%
Annual Average	1960-61	171	65%	127	126%	101	89%	7	350%	4	167%
Average of the Last 2 Water Years	1959-61	181	69%	113	112%	79	70%	5	250%	3	125%

TABLE 7

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-81.1; Above Saltville

DISCHARGE, HARDNESS AND CHLORIDES
From 12 Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '60	36	141	27	4	1
Nov.	40	173	27	17	4
Dec.	71	163	62	11	4
Jan. '61	96	108	56	5	3
Feb.	84	101	46	15	7
Mar.	344	109	202	2	4
Apr.	334	89	161	3	5
May	190	138	142	7	7
June	553	82	245	4	12
July	75	141	57	3	1
Aug.	148	164	131	5	4
Sept.	80	113	49	4	2
AVG.	171	127	101	7	4
Max.	553	164	245	15	12
Min.	36	82	27	2	1

TABLE 8

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-81.1; Above Saltville

DISCHARGE, HARDNESS AND CHLORIDES
From 12 Sample Collections During The
October 1959 - September 1960 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '59	-	-	-	-	-
Nov.	127	96	50	2	1
Dec.	281	82	36	3	1
Jan. '60	174	105	60	6	3
Feb.	362	96	50	1	1
Mar.	308	90	44	2	1
Apr.	334	65	23	2	1
May	177	110	65	2	1
June	64	125	84	7	5
July	222	73	29	3	1
Aug.	36	128	88	11	8
Sept.	30	111	66	5	3
AVG.	192	98	54	4	2
Max.	362	128	88	11	8
Min.	30	65	23	1	1

TABLE 9

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-78.1; Below Olin Mathieson

DISCHARGE, HARDNESS & CHLORIDES
Average for the last three Water Years

"1960 Report" Data for 1952-1956

Compared With:

Most Recent Data Collected During The
1958-1959; 1959-1960; & 1960-1961 Water Years

	PERIOD	DISCHARGE		HARDNESS as $CaCO_3$				CHLORIDES as Cl			
		cfs	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56
1960 Report Data	1952-56	261	-	2694	-	1708	-	2986	-	1843	-
Annual Average	1958-59	200	76%	2789	104%	1391	82%	2977	99%	1480	80%
Annual Average	1959-60	297	114%	1965	73%	1609	94%	2090	70%	1712	93%
Annual Average	1960-61	293	112%	2375	88%	1550	91%	2527	85%	1649	89%
Average of the last 3 Water Years	1958-61	263	101%	2379	88%	1517	89%	2531	85%	1614	88%

TABLE 10

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-78.1; Below Olin Mathieson

DISCHARGE, HARDNESS AND CHLORIDES
From 365 Daily Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE	HARDNESS		CHLORIDES	
	cfs	as $CaCO_3$		as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '60	35	4,540	855	4,831	910
Nov.	45	4,652	1,135	4,950	1,208
Dec.	70	4,565	1,695	4,857	1,802
Jan. '61	163	2,145	1,762	2,283	1.875
Feb.	863	1,588	2,265	1,690	2,409
Mar.	556	490	1,362	520	1,449
Apr.	422	720	1,545	767	1,644
May	550	890	2,200	948	2,341
June	471	1,182	1,928	1,258	2,050
July	114	2,168	1,215	2,305	1,292
Aug.	157	2,145	1,348	2,282	1,433
Sept.	74	3,412	1,290	3.630	1,373
AVG.	293	2,375	1,550	2,527	1,649
Max.	863	4,652	2,265	4,950	2.409
Min.	35	490	855	520	910

TABLE 11

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-78.1; Below Olin Mathieson

DISCHARGE, HARDNESS AND CHLORIDES
From 365 Daily Sample Collections During The
October 1959 - September 1960 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/1	M#/Day	mg/1	M#/Day
Oct. '59	222	2,031	2,026	2,161	2,155
Nov.	328	1,881	2,681	2,001	2,852
Dec.	428	846	1,844	900	1,962
Jan. '60	366	897	1,574	954	1,675
Feb.	516	681	1,750	724	1,862
Mar.	692	807	1,914	859	2,036
Apr.	504	764	1,453	813	1,546
May	229	1,427	1,497	1,518	1,593
June	79	2,852	1,183	3,034	1,259
July	123	3,041	1,466	3,235	1,560
Aug.	56	3,788	1,100	4,030	1,170
Sept.	33	4,563	823	4,854	876
AVG.	297	1,965	1,609	2,090	1,712
Max.	692	4,563	2,681	4,854	2,852
Min.	33	681	823	724	876

TABLE 12

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-78.1; Below Olin Mathieson

DISCHARGE, HARDNESS AND CHLORIDES
From 365 Daily Sample Collections During The
October 1958 - September 1959 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '58	36	4,308	842	4,583	896
Nov.	48	4,401	1,055	4,682	1,122
Dec.	119	4,187	1,573	4,454	1,673
Jan. '59	306	948	1,609	1,009	1,712
Feb.	286	1,033	1,294	1,099	1,377
Mar.	377	1,135	1,814	1,207	1,930
Apr.	772	543	2,013	578	2,142
May	216	1,608	1,904	1,711	2,026
June	98	2,762	1,161	2,938	1,235
July	48	4,088	1,076	4,349	1,145
Aug.	61	4,374	1,402	4,653	1,491
Sept.	42	4,195	946	4,463	1,006
AVG.	200	2,798	1,391	2,977	1,480
Max.	772	4,401	2,013	4,682	2,142
Min.	36	543	842	578	896

TABLE 13

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-8.8; Near Gate City, Va.

DISCHARGE, HARDNESS & CHLORIDES
Average for the last three Water Years

"1960 Report" Data for 1952-1956

Compared With:

Most Recent Data Collected During The
1958-1959; 1959-1960; & 1960-1961 Water Years

	PERIOD	DISCHARGE		HARDNESS as $CaCO_3$				CHLORIDES as Cl			
		cfs	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56
1960 Report Data	1952-56	781	-	1240	-	1989	-	1070	-	1849	-
Annual Average	1958-59	357	46%	1118	90%	1497	75%	1264	118%	1454	79%
Annual Average	1959-60	1208	155%	1496	121%	2237	118%	710	66%	1797	97%
Annual Average	1960-61	1243	159%	-	-	-	-	804	75%	1969	106%
Average of Last 3 Water Years	1958-61	769	98%	1177	95%	2087	105%	1025	96%	1656	90%

TABLE 14

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-8.8; Near Gate City

DISCHARGE, HARDNESS AND CHLORIDES
From 12 Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '60	103	-	-	1,641	913
Nov.	97	-	-	1,719	900
Dec.	1,420	-	-	888	6,809
Jan. '61	395	-	-	781	1,666
Feb.	9,160	-	-	104	5,144
Mar.	1,020	-	-	261	1,438
Apr.	1,100	-	-	262	1,556
May	426	-	-	287	660
June	315	-	-	537	913
July	494	-	-	700	1,867
Aug.	295	-	-	500	796
Sept.	91	-	-	1,969	967
AVG.	1,243	-	-	804	1,969
Max.	9,160	-	-	1,719	6,809
Min.	91	-	-	104	660

TABLE 15

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-8.8; Near Gate City

DISCHARGE, HARDNESS AND CHLORIDES
From 12 Sample Collections During The
October 1959 - September 1960 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '59	618	287	958	451	1,505
Nov.	2,200	472	5,607	140	1,663
Dec.	1,100	357	2,121	304	1,806
Jan. '60	498	6,050	16,268	585	1,573
Feb.	1,120	312	1,887	300	1,814
Mar.	7,480	-	-	137	5,534
Apr.	558	-	-	813	2,450
May	250	-	-	911	1,230
June	201	-	-	1,409	1,529
July	126	-	-	1,256	854
Aug.	250	-	-	600	810
Sept.	91	-	-	1,615	794
AVG.	1,208	1,496	5,368	710	1,797
Max.	7,480	6,050	16,268	1,615	5,534
Min.	91	287	958	137	794

TABLE 16

NORTH FORK OF THE HOLSTON RIVER
@ River Mile NH-8.8; Near Gate City

DISCHARGE, HARDNESS AND CHLORIDES
From 27 Sample Collections During The
October 1958 - September 1959 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '58	116	1,530	955	1,772	1,102
Nov.	140	1,603	1,250	2,086	1,581
Dec.	396	1,455	2,648	1,529	2,912
Jan. '60	456	437	1,034	335	805
Feb.	374	470	2,263	274	1,203
Mar.	441	568	1,353	549	1,307
Apr.	684	147	702	109	520
May	308	67	111	65	108
June	178	1,568	1,507	2,054	1,974
July	168	1,890	1,715	1,637	1,485
Aug.	150	1,344	1,089	1,420	1,150
Sept.	54	1,632	476	2,051	598
AVG.	357	1,118	1,497	1,264	1,454
Max.	1,300	2,061	8,256	2,234	7,772
Min.	54	67	111	65	108

TABLE 17

SOUTH FORK OF THE HOLSTON RIVER
At River Mile SH-1.2

DISCHARGE & HARDNESS
Average for the last three Water Years

"1960 Report" Data for 1952-1956

Compared With:

Most Recent Data Collected During the
1958-1959; 1959-1960; & 1960-1961 Water Years

	PERIOD		DISCHARGE			HARDNESS as $CaCO_3$	
		cfs	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56
1960 Report Data	1952-56	2150	-	108	-	1395	-
Annual Average	1958-59	2425	113%	109	101%	1235*	89%
Annual Average	1959-60	2817	131%	109	101%	1564*	111%
Annual Average	1960-61	2290	107%	-	-	1581*	113%
Average of the 1958-61 Water Years	1958-61	2511	117%	-	-	1460	105%

* = Mean Hardness as $CaCO_3$ in 1,000 pounds/day at SH-6.0 (TABLE 18) plus 371,000 pounds per day (assumed industrial and tributary contribution).

TABLE 18

SOUTH FORK OF THE HOLSTON RIVER
At River Mile SH-6.0; Kingsport Waterworks Intake

DISCHARGE & HARDNESS

From Daily Samples Collected During the
1958-1959; 1959-1960; & 1960-1961 Water Years

	1958-1959 WATER YEAR			1959-1960 WATER YEAR			1960-1961 WATER YEAR		
	DISCHARGE	HARDNESS as $CaCO_3$		DISCHARGE	HARDNESS as $CaCO_3$		DISCHARGE	HARDNESS as $CaCO_3$	
	cfs	mg/1	M/Day	cfs	mg/1	M/Day	cfs	mg/1	M/Day
October	3850	59	1226	2008	56	605	1982	73	761
November	3218	62	1080	1787	76	734	2056	96	1064
December	3904	62	1307	2665	89	1280	2446	107	1415
January	3459	62	1156	1939	118	1237	1336	107	772
February	1775	63	605	2749	97	1442	1957	118	1247
March	1859	73	734	2816	86	1307	2425	119	1561
April	2115	71	810	3742	73	1474	2076	128	1436
May	1789	77	745	2051	75	832	1582	120	1026
June	1510	77	624	2908	77	1210	3117	96	1615
July	1647	74	659	2328	75	945	2232	79	950
August	2032	70	761	3463	75	1404	2853	83	1280
September	1848	63	626	5433	63	1847	3491	75	1415
MEAN	2425	68	864	2817	80	1193	2290	100	1210
MAXIMUM	3904	77	1307	5433	118	1847	5433	128	1615
MINIMUM	1510	59	605	1787	56	605	1336	73	761

TABLE 19

HOLSTON RIVER @ JOHN SEVIER STEAM PLANT
@ River Mile H-106.5; Near Rogersville, Tennessee

DISCHARGE, HARDNESS & CHLORIDES
Average for the last three Water Years

"1960 Report" Data for 1952-1956

Compared With:

Most Recent Data Collected During The
1958-1959; 1959-1960; & 1960-1961 Water Years

	PERIOD	DISCHARGE		HARDNESS as $CaCO_3$				CHLORIDES as Cl			
		cfs	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56	mg/1	% of '52-'56	M#/Day	% of '52-'56
1960 Report Data	1952-56	3370	-	210	-	3811	-	107	-	1950	-
Annual Average	1958-59	2921	87%	195	93%	2749	72%	96	90%	1252	64%
Annual Average	1959-60	3656	108%	202	96%	3940	103%	96	90%	1739	89%
Annual Average	1960-61	3114	93%	223	106%	3603	95%	114	107%	1970	101%
Average of the Last 3 Water Years	1958-61	3219	96%	207	98%	3434	90%	102	95%	1649	84%

TABLE 20

HOLSTON RIVER @ JOHN SEVIER STEAM PLANT
@ River Mile H-106.5; Near Rogersville, Tenn.

DISCHARGE, HARDNESS AND CHLORIDES
From 50 Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		ppm	M#/Day	ppm	M#/Day
Oct. '60	1,604	159	1,409	85	810
Nov.	1,201	232	1,504	121	768
Dec.	2,241	271	3,537	130	1,613
Jan. '61	3,553	246	4,675	205	4,013
Feb.	4,731	265	4,471	135	2,873
Mar.	3,168	181	3,100	66	1,137
Apr.	5,790	205	6,588	96	3,202
May	2,912	246	3,918	109	2,049
June	3,992	222	4,746	143	3,040
July	2,333	197	2,830	120	1,945
Aug.	2,407	238	3,118	68	926
Sept.	4,335	202	4,406	73	1,416
AVG.	3,114	223	3,603	114	1,970
Max.	16,896	460	11,491	328	8,970
Min.	938	125	633	18	93

TABLE 21

HOLSTON RIVER @ JOHN SEVIER STEAM PLANT
@ River Mile H-106.5; Near Rogersville, Tenn.

DISCHARGE, HARDNESS AND CHLORIDES
From 51 Sample Collections During The
October 1959 - September 1960 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		ppm	M#/Day	ppm	M#/Day
Oct. '59	2,107	202	2,272	100	1,095
Nov.	2,731	235	3,023	155	1,892
Dec.	5,288	261	7,724	104	3,206
Jan. '60	3,728	176	3,584	86	1,712
Feb.	4,118	248	5,665	52	980
Mar.	4,889	177	4,849	90	2,785
Apr.	5,764	188	4,818	70	1,742
May	2,997	190	3,077	171	2,640
June	2,497	186	2,442	76	1,031
July	2,585	162	2,202	110	1,572
Aug.	2,302	182	2,307	69	895
Sept.	5,208	212	6,180	41	1,287
AVG.	3,656	202	3,940	96	1,739
Max.	12,566	525	17,536	370	8,110
Min.	1,098	105	952	15	236

TABLE 22

HOLSTON RIVER @ JOHN SEVIER STEAM PLANT
@ River Mile H-106.5; Near Rogersville, Tenn.

DISCHARGE, HARDNESS AND CHLORIDES
From 52 Sample Collections During the
October 1958 - September 1959 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		ppm	M#/Day	ppm	M#/Day
Oct. '58	3,833	168	3,398	61	1,173
Nov.	2,313	225	2,734	109	1,267
Dec.	4,131	204	4,536	50	1,095
Jan. '59	5,013	230	3,104	33	476
Feb.	3,923	246	4,708	140	2,749
Mar.	3,596	228	4,138	120	1,892
Apr.	7,031	150	5,226	68	2,336
May	2,186	278	2,980	155	1,597
June	1,478	224	1,820	192	1,495
July	1,447	97	792	24	195
Aug.	1,231	79	532	38	218
Sept.	1,094	280	1,706	159	974
AVG.	2,921	195	2,749	96	1,252
Max.	13,517	430	10,214	425	3,543
Min.	988	20	114	12	89

TABLE 23

HOLSTON RIVER
@ River Mile H-9.5; Near Mouth @ Knoxville

DISCHARGE, HARDNESS AND CHLORIDES
From 365 Daily Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$ mg/l	HARDNESS as $CaCO_3$ M#/Day	CHLORIDES as Cl mg/l	CHLORIDES as Cl M#/Day
Oct. '60	5,910	138	4,542	56	1,891
Nov.	7,884	150	6,016	69	2,748
Dec.	4,201	178	4,001	86	2,008
Jan. '61	2,969	184	2,976	72	1,295
Feb.	1,852	157	1,458	48	474
Mar.	3,731	167	3,313	51	1,184
Apr.	2,131	152	1,778	27	467
May	2,538	159	2,214	44	629
June	2,995	157	2,563	44	746
July	5,352	163	4,752	54	1,858
Aug.	8,007	174	7,557	70	3,021
Sept.	6,330	166	5,650	76	2,617
AVG.	4,477	162	3,902	58	1,578
Max.	15,800	223	14,163	126	5,887
Min.	254	80	212	6	33

Samples collected at N. E. Knox Utility District raw water intake @ Mile H-9.5. Flow measured by USGS flow gage @ Mile H-5.5.

TABLE 24

FRENCH BROAD RIVER
@ River Mile FB-3.9; Near Mouth @ Knoxville

DISCHARGE, HARDNESS AND CHLORIDES
From 365 Daily Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE cfs	HARDNESS as CaCO$_3$		CHLORIDES as Cl	
		mg/1	M#/Day	mg/1	M#/Day
Oct. '60	6,880	50	1,862	10	344
Nov.	5,715	53	1,469	12	329
Dec.	4,230	59	1,323	15	348
Jan. '61	5,349	62	1,751	12	374
Feb.	6,072	60	1,848	7	235
Mar.	14,005	48	3,473	5	384
Apr.	5,177	56	1,539	4	117
May	5,218	56	1,546	5	148
June	4,333	55	1,258	5	128
July	8,719	49	2,293	7	320
Aug.	10,073	43	2,339	8	443
Sept.	11,657	36	2,281	8	485
AVG.	7,302	52	1,915	8	305
Max.	35,700	75	8,081	20	1,114
Min.	283	31	90	2	12

Samples collected at Knox Chapman Utility District raw water intake @ Mile FB-3.9. Flow measured by USGS flow gage @ Mile FB-7.5.

TABLE 25

TENNESSEE RIVER
@ River Mile T-649.2; at Knoxville

DISCHARGE, HARDNESS AND CHLORIDES
From 365 Daily Sample Collections During The
October 1960 - September 1961 Water Year

MONTH	DISCHARGE cfs	HARDNESS as $CaCO_3$		CHLORIDES as Cl	
		mg/l	M#/Day	mg/l	M#/Day
Oct. '60	15,110	92	7,695	34	2,916
Nov.	15,590	115	9,012	51	4,063
Dec.	10,270	128	7,084	60	3,318
Jan. '61	9,839	117	6,311	47	2,608
Feb.	8,497	93	3,921	26	1,030
Mar.	19,789	80	8,904	18	2,461
Apr.	8,654	85	4,084	13	819
May	8,926	87	4,300	19	982
June	8,457	95	4,566	22	1,190
July	16,095	95	8,378	27	2,429
Aug.	20,632	105	12,128	41	4,602
Sept.	20,087	83	9,590	36	4,027
AVG.	13,595	98	7,164	33	2,537
Max.	46,500	189	28,376	102	11,986
Min.	1,460	14	241	4	637

APPENDIX B

SUMMARY OF CONFERENCE OF INTERSTATE POLLUTION

SUMMARY OF CONFERENCE

(FIRST SESSION)

POLLUTION OF INTERSTATE WATERS

NORTH FORK OF THE HOLSTON RIVER

(VIRGINIA-TENNESSEE)

September 28, 1960

The North Fork of the Holston River which originates in Western Virginia in Bland County, is approximately 100 miles long and has a drainage area of 672 square miles. It flows in a southwesterly direction, crosses the Virginia-Tennessee border at river mile 4.9, and joins the South Fork of the Holston River below Kingsport, Tennessee, to form the Holston River, a tributary of the Tennessee River.

On the basis of a written request to the Surgeon General dated May 31, 1960 from Dr. R. H. Hutcheson, Chairman, Tennessee Stream Pollution Control Board, the official water pollution control agency of the State of Tennessee; and on the basis of reports, surveys, and studies, having reason to believe that pollution of the interstate waters of the North Fork of the Holston River is endangering the health or welfare of persons in Tennessee, a State other than that in which the discharges originate, the Surgeon General on August 5, 1960 called a conference in the matter of pollution of the interstate waters of the North Fork of the Holston River (Virginia-Tennessee) under the provisions of Section 8 of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)).

The conference was held on September 28, 1960 in the auditorium of the Kingsport Utilities Company, Kingsport, Tennessee.

The following conferees representing the State water pollution control agencies of Virginia and Tennessee, and the Public Health Service, participated in the conference.

Dr. R. H. Hutcheson, Tennessee Stream Pollution Control Board.

Mr. Ross Walker, Virginia State Water Control Board.

Mr. H. W. Chapman, U.S. Public Health Service, Atlanta, Georgia

Mr. Murray Stein, Chairman, U.S. Public Health Service, Washington, D.C.

Also participating in the conference were the following:

Mr. E. Block, Senior Vice President, Olin Mathieson Chemical Corporation, Chief, Chemicals Division, Baltimore, Maryland.

Mr. Milo Churchill, Tennessee Valley Authority, Division of Health and Safety.

Mr. A. B. Coleman member of Chamber of Commerce, Kingsport, Tennessee.

Mr. J. W. Erwin, Director, Sullivan County Health Department, Sullivan, Tennessee.

Mr. C. C. Hightower, Production Manager, Olin Mathieson Chemical Corporation, Chemicals Division, Baltimore, Maryland.

Mr. S. A. Johnson, Sanitarian, Public Health Department, Washington County, Tennessee.

Mr. S. Leary Jones, Executive Secretary, Tennessee State Water Pollution Control Board, Nashville, Tennessee.

Mr. F. W. Kittrell, U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Mr. C. K. Marsh, City Manager of Kingsport, Tennessee.

Mr. Mayland H. Muse, Chairman, Pollution Committee, Tennessee Conservation League, Johnson City, Tennessee.

Mr. A. H. Paessler, Executive Secretary, Virginia Water Pollution Control Board.

Mr. John J. Quinn, Chief Chemist, Knoxville, Tennessee Water Plant.

Mr. L. W. Roznoy, Olin Mathieson Chemical Corporation, New York, New York.

Mr. William J. Stearns, Tennessee State Planning Commission, Johnson City, Tennessee.

The chairman of the conference pointed out that:

1. Under the Federal Water Pollution Control Act (33 U.S.C. 466g(c)), pollution of interstate waters which endangers the health or welfare of persons in a state other than the one in which the discharge originates is subject to abatement under the procedure described in Section 8 of that Federal Act.

2. The first step of this procedure is the calling of a conference.

3. The purpose of the conference is to bring the states and the Public Health Service together to lay a basis for future action by all parties concerned and to give the states and localities an opportunity to take remedial action which may be indicated under state and local law.

In the light of the conference discussions the conferees unanimously made the following conclusions and recommendations:

1. That the North Fork of the Holston River is an interstate water within the meaning of the Federal Water Pollution Control Act.

2. That pollution of interstate waters subject to abatement under the Federal Water Pollution Control Act is occurring in the North Fork of the Holston River; (Allegations were noted which claimed that water quality of the North Fork of the Holston River was deteriorated so as to interfere with its use for: a. Public water supplies; b. Industrial water supplies; c. Recreation (including deficiency of fish, cloudy or milky appearances of the river, and muck on the bottom of the river and on the banks following high flows) Substantially all damage to recreation occurs in Virginia).

3. That discharges of industrial wastes from the Olin Mathieson Chemical Corporation at Saltville, Virginia are a major source of such pollution.

4. That measures presently used for the disposal of industrial wastes from the Olin Mathieson Chemical Corporation at Saltville, Virginia, are not adequate to secure abatement of pollution of the North Fork of the Holston River sufficient to meet desired water quality.

5. That with reference to the nature of delays, if any, being encountered in abating the pollution, Olin Mathieson management states there are no known corrective measures which are economically feasible so as to permit the operation of the Saltville plant on a competitive basis.

6. That this is to be considered the first session of that conference and that the second session will be called by the chairman not later than one year from the conclusion of this first session.

7. That the Olin Mathieson Chemical Corporation and the water pollution control authorities of Tennessee and Virginia will get together to discuss the problem. At the second session of the conference, the Olin Mathieson Chemical Corporation will give its prognosis of the possibility of meeting the problem.

8. That the National Technical Task Committee on Industrial Waste will be requested to arrange for a meeting of all soda-alkali producers in the country in order to stimulate and coordinate, on a nation-wide basis, research to provide effective treatment for wastes produced by this industry.

* * *

MR. WEST: That concludes my reading of the report.

CHAIRMAN STEIN: Thank you.

Are there any comments or questions?

MR. WEST: At this time, or at your pleasure, Mr. Chairman, I would like to call on Mr. Pearce Klazer.

CHAIRMAN STEIN: Let me try to summarize something in one sentence and see if I understand it. When data were presented on hardness figures before, the question was raised whether this reflected the most recent data and whether the hardness was the same or reduced. Statements were made that it was reduced. I think what this analysis shows, at least to me, is that if we take the last three years' average and just project that against a previous average of '52-'56, you will find a reduction in hardness. But in the '52-'56 period there was one high year and that was 1954, which makes for the difference. If we eliminate the year 1954, we have a pretty stable rate of hardness in the river all the way through without appreciable change. This '54 was a high year, which throws things off.

Is that a fair statement?

MR. WEST: That is correct.

CHAIRMAN STEIN: Thank you.

MR. WALKER: May I ask one question?

MR. WEST: Yes.

MR. WALKER: Why was that so in 1954, because of rain conditions or because of operations? Do you have any explanation?

MR. WEST: It would not be rain conditions because we are talking about pounds.

MR. WALKER: I see.

MR. WEST: We didn't attempt to evaluate why. I assume it was loading at the mill, possibly operations, but it is not rain.

CHAIRMAN STEIN: Would you continue, Mr. West?

MR. WEST: Yes.

At your pleasure, Mr. Chairman and Mr. Thoman, I would like to call on Mr. Pearce Klazer, Public Health Engineer with the Public Health Service at Cincinnati. He worked intermittently on this report and would also like to report on a parallel industry study that was made of some of these conditions. Mr. Klazer.

MR. PEARCE KLAZER: Pearce Klazer, Robert A. Taft Sanitary Engineering Center, Assistant Sanitary Engineer.

I am going to briefly relate the results of a spectral analysis involving Olin Mathieson's discharge of calcium chloride to the North Fork Holston River and the hardness in the Tennessee River at Knoxville. This particular analysis was prepared by Mr. Al Wurtler, one of the oceanographers at the Taft Center in Cincinnati.

The data used for this particular spectral analysis were the monthly mean discharges of calcium chloride in thousands of pounds per day emitted to the North Fork Holston River by the Olin Mathieson Corporation in the years 1950 through 1959, and the monthly mean hardness in p.p.m. as calcium carbonate in the raw water of the Knoxville Water Plant.

The simultaneous analysis of these two sets of data indicated that:

1. A strong correlation existed between the two at their 12-month frequencies.

2. Average time of travel from Olin Mathieson's waste outfall on the North Fork Holston River to the Knoxville Water Plant was 7.7 months or 33 weeks.

3. Over the 1950 through 1959 period, 1,000 pounds per day of calcium chloride emitted by Olin Mathieson caused an average of 0.012 p.p.m. hardness at Knoxville. This factor of 0.012 p.p.m. per 1,000 pounds per day of calcium chloride applies to the 1950 through 1959 average Tennessee River flow at Knoxville of 12,542 c.f.s.

This factor of 0.012 p.p.m. resultant hardness per 1,000 pounds per day of discharged calcium chloride can be used as an independent check on past and present data.

1. During the five calendar years used in the September 1960 Public Health Service Holston River Report, Olin Mathieson discharged to the North Fork Holston an average of 1,852,000 pounds per day of calcium chloride. During the same period, the Tennessee River flow at Knoxville averaged 10,240 c.f.s.

2. Accepting the fact that the spectral analysis factor of 0.012 p.p.m. per 1,000 pounds per day of calcium chloride is based on flow conditions of the Tennessee River, which were 12,542 c.f.s., and that the hardness concentration is inversely proportional to flow, then the unit waste discharge factor for the 1952-1956 period would be the product of 0.012 p.p.m. hardness per 1,000 pounds per day calcium chloride, and 12,542 c.f.s. over 10,240 c.f.s., which would give us a revised factor of 0.015 p.p.m. hardness per 1,000 pounds per day of calcium chloride. The product of this factor and the average calcium chloride discharge in thousand pounds per day, or 1,852, would give you 27.8 p.p.m. hardness in the Tennessee River at Knoxville attributable to Olin Mathieson. Per cent wise, this would be 26.6 per cent, since the mean Tennessee River hardness during this period was 106 p.p.m. This agrees with the 26.2 per cent stated in the 1960 Public Health Service Report.

The average flow of the Tennessee River for the 1960-1961 water year, as is used in the 1962 Public Health Service report, was 13,595 c.f.s. at Knoxville. Again by adjusting the discharge factor of 0.012 p.p.m. per 1,000 pounds per day of calcium chloride for flow, we obtain a new average factor of 0.011 p.p.m. The mean discharge of calcium chloride by Olin Mathieson during the 1960-1961 period was 1,722,000 pounds per day.

Thus, Olin Mathieson's contribution to the Tennessee River's hardness at Knoxville is the product of 1,722 and 0.011 or 19.0 p.p.m., which is 19.4 per cent of the 98 p.p.m. total hardness at Knoxville for this period. This per cent agrees favorably with the 20 per cent stated in the 1962 Public Health Service Report.

CHAIRMAN STEIN: Thank you very much.

Are there any questions?

As I understand this, I guess what these fellows have done is make a statistical analysis without looking at the river, feed it into a computer, and come up with the result that people spending years in collecting data and feeding it in have come up with, and this corroborates this result. In other words, this is about substantially what Mr. West reported. This works out statistically and there is a causal relation between the hardness of chlorides in the water and Olin Mathieson and the stream flows as was indicated by our sample takers.

I guess in the future we will be able to sit with the computers and won't have to go to the streams.

Are there any questions or comments? If not, thank you very much for an excellent presentation.

MR. THOMAN: At the informal meeting in Nashville last October, it was agreed that the Public Health Service would present a report on the economics per region. Dr. James Flannery, who is the chief economist in the Technical Service Branch of the Division of Water Supply and Pollution Control, is prepared to discuss this.

DR. JAMES FLANNERY: Thank you, John. You saved me the necessity of introducing myself.

My concern here, my examination deals with the economy of this region. When I refer to region, I mean part of Tennessee, North Fork of the Holston within the State of Tennessee and the Holston River, particularly the counties through which this river flows, or the counties that are immediately adjacent to it that face on the river -- in other words, those the river would constitute a boundary.

Mine is an interpretation of the economic consequences of the quality condition of the river, the effect on economic growth.

The importance of water in economic growth is evident from many considerations. I want to point to one source and give examples of this.

The Council of Appalachian Governors of the eight states in the Appalachian region, of which this section of Holston is one part, have identified -- they have an agenda of six points. The two main points for economic generators stimulating economic growth, accelerating its growth and development, they identify highway development and water resources as prime factors.

I agree with this statement. Tennessee is a member of this council. The council is staffed and is working with the Area Redevelopment Agency of the Federal Government.

Looking down this section, you can look back at history. I don't think our history here is much of a guide. Economic change is taking place in the United States so rapidly and so extensively now that we can actually in a relatively small region such as this one disregard the historical trammels here. Every state is looking to acquire industrial operations. This, of course, helps employment, produces growth. This area here has accepted a limitation upon its economic potential, upon its growth potential to the extent that the quality condition of these waters hampers industrial location, provides a handicap to industrial operations.

If you look down through this list of counties, this area here is not one now that is underdeveloped or in economic distress. In fact, a couple of the counties here display considerable vigor in growth. Sullivan County, this one here, particularly so. However, there are other counties -- Hawkins County just down the line, shows virtually no growth at all, no population increase from 1950 to 1960. It has a couple of industrial plants, and we can account for the Greenland operation of the American Saint Gobain Glass Company. They incur some difficulties because of the quality condition. I am not qualified to speak on this, except there are some offsetting conditions. They impound Bradley Creek. They don't use it directly, the river water itself. They do pump from the river into the creek. They have to take some action, some treatment action to handle the chloride condition of the stream.

Now they are some kind of corporate cousin of Blue Ridge Glass Company that is here in Kingsport. So this company, the Greenland operation, is put in this area not only because of the market situation, their ability to service and distribute to a national market and to obtain the resources necessary to do it, but because they are able to draw on the management skills, the operational skills of their sister organization here in Kingsport. That is certainly a decided advantage to them.

The Holston Ordnance plant here was founded during the war. War-time considerations governed that location generally. You will recognize that war-time economic considerations would be different than the conditions there now.

In other words, they could incur certain difficulties that would be not disregarded, but reduced in their importance at that time that would not prevail today.

If you look down through this area, you say, "What happens here?" Well, states and localities -- every state is involved in inducing corporate operations, industrial operations to come into their area. There is no proof, of course, you say, because you say there were inquiries made. My case does not rest on this.

The situation is here this situation is known to have an adverse water quality condition. In effect, it has been advertised, it has been written into official reports, statements made by state planning development agencies and such publications as engineering records indicating that this has serious limitations for industrial operations because of the quality conditions.

These facts are known to those industrial operators, to concerns who do industrial studies, so this kind of area is oftentimes written off summarily.

An industrial operation says, "Let's consider eastern Tennessee. It has an excellent transportation system, good location between heavy population centers, just north here on the Ohio basins, to the south Atlanta, Birmingham, and so forth." But they screen off without any inquiry being made at all, because of this known quality condition.

An industrial location is somewhat a rational process. Studies will be made and reviewed by management. The final decision oftentimes is made by -- well, so that you will not be able to identify the particular conclusive factor that made for the location -- you can look at it afterwards -- was a historical examination and finding that more or less apparent conditions prevailed in the decision.

But this area here, I would say, looking at it generally, looking at Hawkins County, Grainger County -- some counties may have even lost population, some are growing -- but the rate of growth here is less than the national average. Hawkins hasn't grown at all and other counties have lost -- that is less than the state average. This area is one of the six industrialized areas of the State of Tennessee. The State of Tennessee's projected population increase is, by such organizations as National Planning Association, the Census Bureau and research resources for the future say about 10 per cent growth. That is a lesser growth rate than accorded to the nation, according to other areas.

These kind of projections are based on a historical inference, statistical inference, and my point here is that change is taking place.

Industrial organizations are shifting in the United States. New plants and branch plants and so forth are being located. They are looking at a wide range of possibilities. This area would be a good one to examine to the extent that water using industries, industries depending on a good quality water could not locate here. That represents a loss, a less development of potential of this area. This could be as much as say 50 to 100 industrial jobs here. For every time you have 10 industrial jobs, you get about 15 jobs and associated activities. Communication, transportation, trades and services, work it stores, banks -- the increase in population leading to government activities, schools, municipal services. So you are reducing the impact here of development by a considerable increment to the extent that you accept this condition which is not a natural condition. It is not a condition associated with location nor is it associated with climate. It is, in effect, a man-made condition that has been -- well, over a period of time has been accepted and adjusted downward, accepting a lesser rate of growth.

This has probably been less serious in the past than it will be in the future. The nation wasn't as developed in the past. There wasn't this great impact or change, this so-called population explosion, the shifting of population south and west, a wider distribution here of our economic activity, our industrial activity, and we economists say that for the next 25 or 50 years the regional variations in income, wage rate, development will become reduced so that in the long period, in the 50 year period, it will be virtually indistinguishable.

This area here has had marked changes in this regard since the end of the war, since 1946. Incomes are higher, population better. The number of plants, industrial plants located -- these kind of activities manifest the condition that I described.

So in conclusion, I would say here that water quality, bad water quality is an impairment on economic potential on the development of the area. It means that you limit then your aspirations, those collection of industries that you seek.

To those who do not depend on this facility, the Holston River, the North Fork is an economic asset. It is a condition now that would be satisfactory, if you had a physical plant, a capital investment that you do not maintain, that you defer your maintenance on. Even Sullivan County, the development, even though there is only a small portion of the stream in this area, the industrial water users have to go to the South Fork. It means the potential development that might appear along the North Fork is not available to them.

CHAIRMAN STEIN: Thank you.

Any comments or questions?

Thank you.

Just to bring out one point and then ask about one. As I understand one part of your comment, you are saying that in the next 25 or 50 years the productive capacity and the wage rates of people in various areas of the country will become kind of uniform.

DR. FLANNERY: That is correct.

CHAIRMAN STEIN: And the distinguishing factor in where an industry is going to locate will be based on other things, among those quality of the resources.

DR. FLANNERY: That is correct. The competitive factor that exists now between labor skills, income, this kind that there would be bargaining for among various factors, it will be a high plane, so that when the choices are made, it will be governed on markets, resources and this kind of thing. You won't have this differential, say a better profit, a more profitable arrangement can be made by locating in some spot because labor costs are less there. That will be going. Educational levels will be higher. We are building up a higher cultural standing, higher living amenities. This area is not handicapped in this regard. It has some assets since this is an area of considerable scenic beauty. These kind of things are the intangible factors that are heavily considered.

CHAIRMAN STEIN: Dr. Flannery, I don't know if you are familiar with the action that was had similar to this in Sioux City, Iowa. Here was a city and some of these Missouri towns, St. Joseph and several of the others were in the same situation where they had no industrial or population growth since the '20s. These cities seemed to be static. Of course, many of them had a rather severe pollution problem.

We had several conferences. As a matter of fact, we had a hearing in Sioux City, and it was decided to put in some new treatment facilities.

Within recent years, Sioux City has for the first time -- there may be other factors here -- attracted many new industries, 10 major industries. Many industries in there have expanded. This year they won an award for an All American City for Progress and they themselves listed as the first item in their achievements their moves to correct the pollution problem.

I think all through that area, I think your first point is a key one. Very few industries want to locate in an area where it is reputed that you have a pollution problem, and that may be psychological as much as anything else.

Thank you, Dr. Flannery.

MR. THOMAN: Also at the Nashville meeting we agreed to explore with the Tennessee Valley Authority the possibilities of regulation of some of their discharges to ameliorate or mitigate conditions existing in the river.

General Vogel replied recently that representatives of the Tennessee Valley Authority would be here today to discuss the problem.

Mr. Milo Churchill, who is with the Division of Health and Safety of TVA, will present the first statement in that regard.

Milo, would you also, please, sir, introduce the rest of your group.

MR. MILO CHURCHILL: I would like to introduce, first, Mr. Ross Brudenell, Division of Power; Mr. Lynn Seeber, Division of Law; Mr. Alfred Cooper, Water Control Planning.

I think it pertinent at this time to give a little background on this whole problem, and in that regard I would like to refer you to a statement made by Mr. Leary Jones, Director of Pollution Control of Tennessee, in May 1956 before the Virginia Board in which he said that he believed it reasonable that chloride concentrations in the Holston River, starting below the junction of the two forks, in other words, not exceed a 50 parts per million as an average -- be reduced to 50 p.p.m. or less is the wording -- and that hardness be reduced to about 100 p.p.m. or less.

Keep those figures in mind to appreciate what I am going to try to explain to you.

In other words, the State of Tennessee is asking for 50 p.p.m. chlorides, not more than that and not more than a hundred parts hardness in the Holston River below the two forks.

If now you will imagine all the chloride load coming down the North Fork and all of the chloride coming down the South Fork for an entire year, mixed with all the water coming down those two streams in a great big pot of some kind, and then released over a period of one year, you will find that chloride concentrations are 100 p.p.m., which, of course, is a hundred per cent in excess of what the Tennessee group has asked for.

Similarly, if you do the same with hardness, you release from this tremendous pot, if you will, all the hardness which would be an average mean concentration, you find it nearly 200 p.p.m. In other words, on both counts, the best that you could possibly do with all the water available in both streams is to exceed the Tennessee request by about a hundred per cent.

I think that will give you some background on what it is possible to do with the water available.

Others in the group may care to add to that statement.

CHAIRMAN STEIN: You mean with the water and discharge available?

MR. CHURCHILL: I mean all the water flowing down those two streams.

CHAIRMAN STEIN: Yes. You are assuming the constant discharge of chlorides.

MR. CHURCHILL: I am assuming everything mixed together, all the waste and all the water, would give you uniform concentration. That is the best you could possibly do.

CHAIRMAN STEIN: But the point is, you are assuming that the waste load will not be reduced at all.

MR. CHURCHILL: That is what I am getting at, under those conditions, under existing conditions. That is the 1952-56 load, by the way. I did not have, of course, the later information.

CHAIRMAN STEIN: Again, I think we will need this confirmation from Mr. Jones. I think he stepped out. And, of course, this isn't a hearing. But you base this on an assumption of certain figures, and I think sometimes here --

MR. CHURCHILL: What assumption?

CHAIRMAN STEIN: On the 50 and 100.

MR. CHURCHILL: That is not an assumption, that is a statement made.

CHAIRMAN STEIN: I think we would gain -- this is not a situation where we are dealing with hearsay or anything else, but I think this is a statement which is purported to be made by Mr. Jones, and I think he is here and we should give him an opportunity when he comes in to corroborate just for the record.

MR. CHURCHILL: Just for the record, that is all right. I have it right here in front of me. (Laughter)

MR. THOMAN: Milo, before you get away, what per cent of the time is the average discharge exceeded, say in the North Fork and the South Fork? Could you give us a rough estimate on that?

MR. CHURCHILL: No, I am afraid I couldn't. In other words, stream flow, as you know, is quite variable, and as the discharge goes up, concentration goes down. That is quite obvious. That the higher the discharge goes, the lower the concentration goes. This device is simply -- this little illustration I made is simply to give you an idea of what you can possibly do if you use all the water to the best possible advantage. A simple concept, and I believe it is understandable.

CHAIRMAN STEIN: Mr. Churchill, would it be desirable -- and maybe you are not the one to answer this, but I think you may be -- to have it constant, without variation so the people downstream, as much as possible, would know what the chlorides and hardness they are getting and not have large fluctuations in there? Would that be a desirable feature?

MR. CHURCHILL: It is a little outside of my sphere of discussion, but I would be inclined to agree.

CHAIRMAN STEIN: Okay, thank you.

MR. THOMAN: That concludes our portion of this.

CHAIRMAN STEIN: I think this concludes the Federal portion and perhaps in order that this won't get too deadly, we take a ten minute break now and reconvene.

I think during the break, we may talk. I will talk about this point about the Tennessee requirements and perhaps be able to discuss that when we come back.

We stand in recess for ten minutes.

. . . Short recess . . .

CHAIRMAN STEIN: May we reconvene.

Dr. Hutcheson.

DR. HUTCHESON: Mr. Stein, I have no statement that I want to make for Tennessee. Mr. Jones, who is the Chief Engineer of the Stream Pollution Control, is here and has invited a number of individuals downstream from here. He may have something that he wants to say.

MR. S. LEARY JONES: Mr. Stein, we have invited all the cities, industries and counties -- you might say everyone downstream -- that has an interest. I have not checked the register to know who is here and have had no communication. I am wondering if we could call by towns and areas to make sure that no one is denied the privilege of putting in information?

CHAIRMAN STEIN: Yes. If you wish to do that, why don't you come up here, Mr. Jones, and call your people.

MR. THOMAN: Would you let Mr. Jones have the register.

MR. JONES: I don't think that is necessary. I think I can go down by towns and we can get the names right of those who are here. We might as well start at Kingsport with the city officials here.

I don't know whether Mr. Marsh or Mr. West or some of the other officials have any statement they would like to make into the record. Would not. Thank you.

Then how about some of the industries here at Kingsport? I know we have two or three of the industries here. If they have any statements they would like to put in the record. I know some have looked at sites downstream in connection with water.

I believe last year the Chamber of Commerce had a statement, and I think they should be given a chance to add to it from Kingsport, Sullivan County.

MR. A. B. COLEMAN: I am A. B. Coleman, Executive Vice President of the Chamber of Commerce. I think we pretty much stand on the statement we made last time in that the condition of the stream is very important to our industrial efforts.

The gentlemen a while ago almost made my speech, talking about Saint Gobain.

Mr. Sample is here also who represents Hawkins County, who was working with me on that. And TVA was very cooperative in making studies of the water and advising us, and we were able to locate them anyway, as we have another, as the Kingsport Press has. Of course, they don't use a lot of water, but there are certainly people who cannot tolerate the water for the things that they are doing in Hawkins County. Many of the sites near Kingsport are in that county. Most of our Sullivan County sites are on the South Fork, but we are still vitally interested in making all improvements we can, just as we stated in our statement the other time.

CHAIRMAN STEIN: Are there any comments or questions? If not, Mr. Jones.

MR. JONES: I mentioned the industries here at Kingsport. I know three or four are here. I don't believe any of those had any statements.

Going downstream a little to Rogersville, are there any representatives from that area?

MR. D. S. SAMPLE: I am "Bo" Sample, Industrial Director of Hawkins County. I would be glad to make a statement, if no city officials are here. I did not have time to check if any of the city officials are here.

MR. JONES: Are any of the city officials from Rogersville here? If you will, sir.

MR. SAMPLE: I am sorry I missed the first part of the meeting. I had to attend a funeral and was late in arriving, as you know.

I now represent Hawkins County as their paid industrial director. I have assisted in the Chamber of Commerce work for Kingsport in this area for a number of years, something like eight or ten years. We have given it a lot -- Mr. Coleman and I have given it a lot of attention, and we have looked into the sites in this whole area with the idea that anything that was good for one section was good for the rest of the section. We have been very fair in our summations and in looking at sites. We have been many times handicapped by the analysis of the water, not only in the North Fork as it touched the State of Tennessee down out of Virginia, but also after it had merged with the South Fork water.

I have in my files at my office in Rogersville now late summations and, of course, as the technical people know, the hardness is particularly bad, and the chlorides run as high as 10,000 p.p.m. as compared with normal water in the South Fork of sometimes one to two p.p.m. We have had a number of cases where that entered into the picture because it does require treatment.

It is not an impossible position to take, of course, that it can be treated, because most of those things can be taken out, but it does cost money and a lot of industries who require a lot of water, I am sure, write us off before we even get to hear about them or even get to talk to them.

I understand the statement was made previous to my arrival that a lot of industries did not even get in touch with us because we had the reputation for having bad water. I did not hear that statement, but I understand it was made. I would certainly like to supplement the fact from my own experience that that is true, that I am sure that has happened.

I don't know the solution. I do know this, and I certainly would be the last one wanting industry for this area, with all my good friends in industry upstream, I would certainly be the last one to do anything to harm them, but on the other hand, I feel that the time has come as a member, and we have discussed this -- as a member of the state Planning Commission, Mr. Harold Miller and I have discussed it many times, that if it comes down to brass tacks, one industry cannot keep maybe 15 to 20 big ones from settling in this area. It just isn't fair, and, of course, we are hopeful that some solution can be worked out which is acceptable to those who are already here.

We certainly view it with a great deal of alarm. We know that in our state planning work that water is becoming the most precious thing that we have to offer. That will attract chemical industries and other industries when nothing else will, because they don't make any more land and they don't make any more water. As a matter of fact, the watershed is receding all the time, so it is becoming more valuable.

I believe that is all I have to say, sir.

CHAIRMAN STEIN: Thank you, Mr. Sample.

Are there any comments or questions?

Mr. Jones.

MR. JONES: Yes. Then I think our next town downstream is Morristown, that is using the water from the Cherokee Lake and Holston River. Is anyone here from Morristown City? Mr. Eubanks.

MR. C. E. EUBANKS: I am C. E. Eubanks from Mid-south Engineering Company in Knoxville. We are representing the City of Morristown and the Morristown Power and Water Board at this meeting.

Morristown is very much interested in this matter. They have been fortunate at the present in having a supplementary water supply or spring or well, so that they are not entirely dependent upon the lake water for their water supply.

Morristown is promoting industries to a larger extent than probably any city in the area, except Kingsport. We are developing a large industrial district on the outskirts of town which will use the Morristown city water. So in the future, if it becomes evident that they will have to depend more and more on the waters of the Holston River or Cherokee Lake for their water supply, therefore this matter is of great interest to them. Thank you.

CHAIRMAN STEIN: Thank you, sir.

Any comments or questions?

Mr. Jones.

MR. JONES: Anyone else from the Morristown area? If we skip some area, we will come back to them. Moving on down to Knox County, the City of Knoxville receives part of their water from the Holston, the Knoxville Utility Board.

John, do you have a statement?

MR. JOHN J. QUINN: No, I have no statement.

MR. JONES: Anyone else?

There are two or three other water supplies in that area that receive water from the Holston River.

Then Johnson City, not directly related to the river here, has had an interest in the development of the area. I know Mr. Muse is here from the Tennessee Conservation League, and probably four or five other organizations. Mr. Muse, do you have anything, sir?

MR. MAYLAND MUSE: Well, Leary, I represent the Tennessee Conservation League, which is a total of some 40,000 conservation-minded in this state. We have been very instrumental in getting this Stream Pollution Control Board organized many years ago, and in the talks over the country and the study of different industries, I might say this, that it seems almost like God has a hand in this. They are willing to go along with a program of aiding pollution. In many, many cases, which are too numerous to mention here, it has turned out to be the waste that they receive from the settling basins and other methods that have proven difficult and many times more than the main product of the plant. Time and again that has taken effect, and we have no intentions of hurting any industry. We want to cooperate with them, and I think that America has always accomplished what they wanted to and I think this will be accomplished. We must have patience.

I know when I go to Washington, the Public Health Service meets me there, and Tennessee today leads the nation in sewer disposal plants. We have been first in many, many projects and objectives that we want to accomplish.

This is objectionable, this is unpleasant, but I think we can whip it by all of us cooperating and working together. I don't think it is going to be but a short time until we will have Tennessee as the number one state for clean water in the entire nation.

MR. JONES: I know we have at least three of the ladies from the League of Women Voters. Would you all like to make a statement?

MRS. BRUCE CARRUTH: No, we have no statement.

MR. JONES: I have been handed a note that one of the representatives from one of the game and fish clubs from up in Virginia would like to make a statement.

CHAIRMAN STEIN: Virginia would have to do that. Mr. Roy Wolfe, don't forget him.

MR. JONES: Going on with the Tennessee group, I know there is a representative of the Tennessee Game and Fish Commission. I haven't talked to Mike this morning to see if they wish to make a statement.

MR. MIKE STUBBS: No sir, we don't have a statement.

MR. JONES: How about the State Planning Commission, I believe they had a statement last year. I don't know whether their representative is here or not.

MR. D. S. SAMPLE: I might add that I am on the State Planning Commission. I don't know what they had in last year, but I would like to officially reaffirm whatever statement they had. (Laughter)

MR. JONES: Thank you, sir. It was good last year.

MR. SAMPLE: I know it was good. Bill Miller wrote it.

MR. JONES: Then the Department of Conservation and Commerce, I am not sure whether they have a representative or not in connection with industrial development. I believe they were for it last year, too.

I don't know whether there is a representative from the Water Resource Division of the Conservation Department or not.

These were the lists I went down this morning. Have we forgotten anyone else in Tennessee that has a statement?

I believe that is all.

DR. HUTCHESON: That is all, Mr. Chairman.

CHAIRMAN STEIN: All right, thank you very much.

Mr. Jones, would you wait a moment. I asked Mr. Milo Churchill a question that he didn't feel was in his field, although he certainly had his feelings on that.

If we assume that pollution from chlorides is reduced to its irreducible minimum, and Mr. Churchill gave us some figures just on the basis of what was here, would you think that by adjusting releases and other water quality management, if we could predict what was coming downstream and the people knew what was coming downstream, or we could keep that at a fairly constant level, that that would be a helpful measure on this system?

MR. JONES: Oh, yes, any way that you could come out with a more constant figure in the river, hardness, chlorides, would help tremendously. I have talked to a number of industries in the last year about effect of chlorides, effect of hardness. What we are looking for, no one knows. They all say zero hardness, zero chlorides is what we would like to have, except it would eat our pipes out and we couldn't use it. We are not shooting for that absurd Utopia figure. We know we can't get it.

The main thing though that we do find from industries, particularly on chlorides and on hardness, the real damage is the daily fluctuation, moreso than a seasonal fluctuation. One morning if you have a hardness of 400, by afternoon the hardness is down 100, back up the next morning. It is a very difficult operation and will cause more trouble with plant process than if you ran 200 or 300 continuously. No one actually can put their finger on it.

I spent considerable time last week in Cincinnati asking some of the experts on water quality. They are not sure of what figure either. It all depends on what it is to be used for. If you are raising oysters, the high chlorides are a help. If you are using it for boiler water, then the chlorides or hardness causes damage. You have got to pinpoint exact use downstream in order to get that.

But this fluctuation is the thing that causes more trouble than real concentration. I have seen some figures -- I don't have any here -- but your fluctuation will vary probably two or three hundred per cent within a 24 hour period. I know the flow varies that much, and I know the concentration coming out of the North Holston would be relatively constant day in and day out. You get a wild curve when you plot it. It is very difficult for industry or anyone else using that type of water. Kingsport has had the trouble on ammonia and chlorine demand. I know years ago Mr. West was operating with one hand on his chlorinator and one eye out the window to see whether the river was going up and down.

Anything that could level out the chlorides would help probably as much as per cent reduction in total pounds per day.

CHAIRMAN STEIN: Do you know, Mr. Jones, in the new Federal act there is a feature involving low flow augmentation which carries with it a principle of managing stream flows so these things can be equalized.

I want to make one point clear. The act is very clear that this cannot and should not be used for treatment or reduction of waste at the source. The primary responsibility for treating waste and reducing waste are the people who put this in, and we cannot -- I don't think we can hold out the hope that anyone is going to get any of Uncle Sam's money for low flow augmentation unless the maximum amount of treatment is done at the source. However, once that is done, there are still certain situations where given the best known methods of treatment we still may have a problem which can be alleviated by regulating stream flows and waste discharges.

Now we saw an example of this, what happened today in some earlier statements where these boys now can get the dynamics of a river reduced to mathematics, feed it into a computer and do in a matter of hours what it would take us man years to do before, and we can make predictions.

I think there may be a point here on the Holston River where evidently you may be lucky enough because of the correlation of the sheer mathematical analyses and what we found in emperical observations that this river runs according to a reasonable pattern. When we get to the Missouri River, it doesn't work. No one knows just how that river goes, and this doesn't work as well. This may be one approach.

Again I want to caution this. It is not a substitute for waste reduction at the source and it cannot be made a substitute for waste reduction at the source.

MR. JONES: Flow augmentation is not foreign to Tennessee streams or fluctuation of flows. That has been done since the early '40s and maybe late '30s in connection with malaria control -- the same amount of water released, but released in connection with a different pattern. We have discussed flow variations, not so much flow augmentation as far as more water released, but the rate at which it is released at Kingsport or since the early days when Boone Dam was being designed and Fort Patrick Henry. We did it for two reasons, but here it is strictly quantity in connection with this conference. You do an awful lot on paper, if you could release water the way you want to. There are definite reasons that it cannot be released that way, theoretical averages.

CHAIRMAN STEIN: That we recognize.

MR. JONES: If you could control rainfall and power and use, you might. Anything that would level out that flow would help tremendously.

CHAIRMAN STEIN: Thank you, Mr. Jones.

MR. WALKER: May I ask a question? Just to clear my thinking, you are referring to fluctuation in flow. Is that before or below the dam?

MR. JONES: Below the dams, thinking particularly at Patrick Henry or Boone. The two tie in together. The flow of one would automatically be the flow of the other.

MR. WALKER: In other words, your displacement from the dam is the problem with which you are confronted on that?

MR. JONES: Yes. I know it has been discussed about releasing water at Saltville to match the flow at Patrick Henry Dam. There is some 80 miles distance, and the fact that the time of flow varies, it would be very difficult to match that from that distance. If the two were sitting side by side, it would be very easy to match the flow.

CHAIRMAN STEIN: Does that conclude Tennessee's presentation?

DR. HUTCHESON: Yes.

CHAIRMAN STEIN: Now we would like to call on Mr. Walker.

MR. WALKER: I have no statement. I would like to ask if there is someone from Virginia who wants to be heard. I believe Mr. Jones referred to someone.

Mr. Wolfe, would you like to be heard?

MR. ROY WOLFE: Yes, sir.

MR. WALKER: From a game and fish club in Virginia.

MR. WOLFE: I am Roy Wolfe, Jr., Gate City, Virginia, a practicing attorney in Gate City, and I am here as a spokesman for the Hiltons, Virginia Ruritan Club. It is composed of citizens of the Hiltons Community and citizens of that rural area. They perhaps are as affected more immediately by discharges of these chloride materials into the North Fork of the Holston River and they notice it sooner perhaps than anybody else that is affected by it. Of course, there is an area in Washington County, Virginia that is affected before they are, but apparently the people in Washington County take this view, that the Mathieson Alkali or the Olin Mathieson Industries can do no wrong, and perhaps we in Scott County should take the same view. But suffice it to say, that we do not take that view.

We came here more to state this view. Perhaps to summarize Calvin Coolidge's observation on the preacher's sermon against sin -- "We are against it and we want to have our voice recorded as being against it."

I am a Virginian, and for all intents and purposes -- and I say "all intents and purposes" advisedly -- I am proud of that, but I am not proud of some things that are permitted to go on almost from time immemorial in Virginia. We Virginians have tried for years and years to get some relief from our own Water Control Board and from our own courts, and we have done so, with all due respect to the members of the Water Control Board here present and those absent, without any relief that has amounted to anything much.

From time immemorial The Bottoms in Scott County on the North Fork of the Holston River, with river spring tides, have been left white with chlorides discharged by the Olin Mathieson Industries.

The machinery used by the farmers who have farmlands on the North Fork of the Holston River have had their machinery ruined and rusted and this was caused by the discharge of chloride solutions by the Olin Mathieson Industries.

Now we are told by the Olin Mathieson Industries and we are told by officials from the State of Virginia, even by members of the Water Control Board, that we have the Hobson's choice -- we either have alkali and chloride materials in the river or we close down the Olin Mathieson plant.

We refuse to accept that as an answer. And certainly even if it is an answer, it isn't a solution. I don't think there is any question about where the chloride materials are coming from, and I doubt that there is a question that it can be stopped. No doubt it would be an expensive procedure, but as I have learned here today from having heard Dr. Flannery and other experts that have made their presentations, this is expensive business for the people of Tennessee. I think the people and the powers that be in Virginia owe it to themselves as well as to the people of Tennessee to put a stop to it. I think that this could be done. I don't think it is a Hobson's choice. I don't think it is either this or that. We have heard for years this: "Now what do you want, to fish in the North Fork of the Holston River or the Mathieson Alkali to continue to employ several thousand people?" We want both, and I think we are entitled to both. I think we can have both, if an effort is made and if the powers that be in Virginia would exert the pressure that they have under the existing Virginia law that it could be stopped or it could be reduced to the minimal standards acceptable to most industries without the necessity of this hearing having been held or conducted.

You know when a layman comes into a meeting like this, after having heard the presentations that were made by these experts on the type pollution, percentages and figures that don't very well soak into my dense head, it is sort of like switching from a cello concert to an old-time fiddler, or going from classic Greek to pidgin English or pig Latin.

We did want to come here and insert in the record this fact, that there are Virginians who are opposed as well as those of you in Tennessee who are opposed to the unjustified pollution of one of the finest streams in America or what could be one of the finest streams in America, the North Fork of the Holston River. Not only is it a body of water that should be pure and unpolluted, it could be one of the finest fish streams in America for the sportsmen of Virginia and this entire section of the country. And we want you to know that we are opposed to it, and we came here for that purpose, to assert our opposition in the record of this hearing.

CHAIRMAN STEIN: Thank you, sir.

Any comments or questions?

MR. WALKER: Anyone else from Virginia who would like to be heard in connection with this? If not, I think it would be appropriate at this time to ask representatives of Olin Mathieson to state their situation with respect to it.

MR. JOHN O. LOGAN: Mr. Chairman, I am John Logan, Vice President of Olin Mathieson and General Manager of the Chemicals Division which is responsible for the operation of the Saltville plant.

By way of introduction, since I was not at the conference last fall and may, therefore, appear to be a new face, I would like to say that I have been aware of and concerned with and involved in this matter for some years. Going back several years, I have met with the Virginia Water Board in connection with the Saltville problem. I was present several years ago, as Mr. Walker may recall, at a meeting in Richmond, at which time Mr. Osborne, the president of our company stated that it was his policy and the policy of the company that we would use all of the effort at our command, working with the proper authorities, to find solutions to this problem and to accelerate any methods of control that might come to our attention. I would like to reiterate that statement by our president which still applies.

We have here today, because of our interest, several members of our organization. I will not ask them to stand, but we have Mr. Nicholson, our Vice President of Manufacturing, Mr. Roznoy, our Manager of Pollution Control, and three members of our Operating Production Department, including the manager of the Saltville plant.

My presentation will consist of some comments regarding Mr. Deutsch's report, and for the record we would like to introduce these comments as they appear in this record and I will talk in a summary fashion from my copy.

CHAIRMAN STEIN: You will give a copy of that to the reporter?

MR. LOGAN: Yes. Additional copies will be made available to the conferees, if they so desire.

Before discussing Mr. Deutsch's report, I would like to comment on some of the presentation you have heard this morning, because some of these thoughts are fresh in our minds.

First of all, I know you have all said what you have had to say with great sincerity. You believe what you have said. We do likewise believe what we are going to say.

I want to compliment Mr. West on the accumulation of data and on the presentation of it, and just remind you that a great deal of the data actually has come from information supplied by us through our testing and control program. We have expended considerable effort in recent years to intensify our collection of data and to improve our control mechanisms.

In this connection, I think I would just like to point out from Mr. West's data, if he will permit me, that during this period you will observe large variations in the annual average, and commencing at approximately this period, the average annual flucations are quite reduced. I think with respect to the annual averages this is evidence of substantially improved control and testing of the water as it leaves, goes downstream from our plant.

In connection with Dr. Flannery's comments regarding growth of the area, I would like to start from a slightly different direction.

For many, many years Saltville was the only alkali plant in the south and southeastern section of the country. Saltville is today the only soda ash plant in the southeastern section of the country. For those industries that use soda ash, namely pulp and paper, glass, chemicals, and a host of others, and for those industries that have developed based upon the ammonium soda caustic that was produced at Saltville, namely rayon, paper, textiles and others, much of the present economic base of this section of the country results from the fact that Saltville was placed where it was. In looking for locations, manufacturers of goods have to analyze several aspects. We happen to do this on a fairly regular basis ourselves, because we are constantly adding plants to our circuit of facilities.

One of the most important characteristics of a community that draws industry to it is the availability of raw materials and much of this segment of the country has developed based upon raw materials made available at Saltville.

In the last conference report it was pointed out that a soda ash plant must be located where there is suitable and adequate limestone and salt. Soda ash is one of our economy's basic chemical raw materials. Saltville happens to be and was back in the 1890s the site where suitable limestone and salt were available together.

I only want to emphasize, therefore, that while we talk about the growth of an economy, we must also recognize that the economy has grown to its present stature to a great extent based upon raw materials that have been made available through Saltville.

I might also comment with respect to the water supply. Not only is the quality of water of concern to industry, but the volume of water. The North Fork of the Holston River is no Tennessee, it is no Ohio, and it is no Mississippi. And to the extent that volume is a factor, those people who live upon it cannot expect to duplicate the kind of industrial development that you can get where there is a larger flow of water.

In fact, if the North Fork of the Holston were a Tennessee, or a Ohio, or a Mississippi, there would be no purpose in this meeting. Because those rivers, the Ohio and the Mississippi, not the Tennessee, are already satisfactorily disposing of the waste from other soda ash plants in exactly same manner as the limited flow in the Holston, with the exception that the volume of flow is such that the problem is of minor consequence.

So don't forget that while we do have a quality problem here, the matter of flow is also of importance.

I don't need to remind you, I am sure, that the Saint Gobain Glass Plant did locate here in spite of this condition.

Now I would like to comment a bit on the representative from Hawkins County Development Board. I think he referred to 10,000 p.p.m. chloride -- is that correct? Page 27 of Mr. West's report shows that during 1960 and 1961 the average chloride content was 114 p.p.m. Our records would indicate that in the past several years there has never been a concentration just out of the Saltville plant approaching 10,000 p.p.m. So I think we must be misinterpreting the data somewhat here.

Let me get on with our formal comment regarding Mr. Deutsch's report that was prepared for the Public Health Service.

No one in the alkali industry or the chemical business questions Mr. Deutsch's reputation in this field and, therefore, after reviewing this report, we were pleased to note that there was considerably similarity between it and the one prepared by the industrial representatives for the National Task Force Committee.

. . . The formal comments of Mr. Logan are as follows . . .

On October 19, 1961, representatives of Olin Mathieson Chemical Corporation attended a meeting of the conferees in Nashville, Tennessee. The purpose of the meeting was to reach agreement on the conclusions and recommendations made at the Kingsport, Tennessee conference of September 28, 1960. At the October 19 meeting, Mr. Murray Stein informed the group that Mr. Z. G. Deutsch had been engaged by the PHS in a consultant capacity and that he had prepared a report entitled, "Amelioration of River Pollution by Alkali Factories". Since a copy of the report was received subsequent to the meeting, we would like to express our thanks at this time for the opportunity offered us to discuss it.

After reviewing Mr. Deutsch's report, we were pleased to note that there was a great deal of similarity between it and the one prepared by the industrial representatives for the National Technical Task Committee for Industrial Wastes (NTTCIW). We are pleased to report that of the eight recommendations made by Mr. Deutsch, the first seven have been considered or investigated by Olin, the eighth did not receive consideration since it is believed to be impractical. In addition, Olin has looked into two other possibilities not mentioned by Mr. Deutsch

Since Mr. Deutsch has stated the eight recommendations made were listed in the approximate order of their promise of improvement, we will submit our comments in the same order in which they were presented.

1. Conversion to Electrolytic Alkali Method

Although Mr. Deutsch has indicated that the production of alkali via a conversion to an electrolytic method holds the greatest promise for pollution abatement, he very significantly points out, and justifiably so, that the success of such an operation is dependent upon the sales of the two co-products, caustic and chlorine, which incidently, have never been in balance. Mr. Deutsch shows a good appreciation of the economics of the problem when he states that it is almost never possible to remain in business when either of the two co-products must be dumped either physically or at distress prices. In this connection it should be borne in mind that fluctuations in market conditions exist and frequently create greater demands for one of the products. It is imperative, therefore, to have other sources of caustic and chlorine in order to maintain a balance of sales.

The manufacture of soda ash from caustic does not solve the problem since quite often the reverse requirement is necessary which allows lime soda caustic to be used. Until market requirements dictate and equalize the demand requirements for caustic and chlorine, it will be necessary to dispose of either chlorine or caustic, whichever of the two products is in lesser demand.

I might say here that the Saltville market for chlorine, which would be the co-product of this type of operation, simply is not adequate even to accept the already existing production of chlorine at Saltville. Just yesterday some of my associates and I discussed the fact that it was necessary for us to take a quite unsatisfactory commitment to supply chlorine into Charleston, West Virginia, upon which chlorine we have a very low return. It was necessary to accept this commitment for a period of a year and a half in order to keep the Saltville electrolytic plant running at a reasonable level.

Now Charleston, West Virginia, as you all know, has a substantial production of chlorine right there in the chemical plants of that area, so the Saltville normal market is not adequate to accept more electrolytic production of alkali, at least in the foreseeable future.

The economic fallaciousness of carbonation of electrolytic caustic is explained in the NTTCIW Soda Ash Report which states that if the electrolytic caustic is taken at no value, the process might be feasible. Since caustic soda sells at approximately $54/ton, the price of soda ash made by this process would have a minimum cost of $41/ton based on equivalent akalinity. Soda ash made by the ammonia-soda process is priced at approximately $31.50/ton.

Conversion of the Saltville facilities is not practical for several reasons. Initially, the conversion would be too expensive because it would require a complete revamping of the soda ash plant. A majority of present soda ash facilities would become obsolete. In order to produce 1,000 tons of soda ash/day, 672 tons of additional chlorine and the carbonation of 755 tons of caustic would be necessary. The imbalance which Mr. Deutsch refers to would be seriously out of proportion since it would be impossible to sell chlorine competitively in those quantities as Saltville is not strategically located geographically nor is it in proximity to a major chemical producing area.

2. Improved and/or More Extensive Impounding

The fact that Mr. Deutsch places improved and/or more extensive impounding in the number two spot comes as no surprise to those familiar with the effluent characteristics of ammonia soda wastes. The Industrial Committee, in its NTTCIW report, also recognized this fact since the method has proved to be the acceptable abatement measure to the authorities in those states in which soda ash plants are located. In fact, it is the only recognizable treatment method practiced and is currently in effect at Saltville and has been since 1895.

The matter of chloride control was projected on a national scale a few years ago when the Ohio River Valley Sanitation Commission (ORSANCO) was considering the adoption of a chloride-control measure. After several years of deliberations, conferences, hearings, etcetera, it adopted a resolution on September 12, 1958 which resolved that:

(1) Existing and future discharges of wastes containing significant chloride loads shall be subject to control by impoundment or by such other methods as may be acceptable to the water pollution control agency of the state in which the discharge originates so as to insure that the amount shall conform to the discharge schedule to be formulated for the purpose of maintaining an acceptable proportion between the amount of such chloride-containing wastes and the volume of flow in the stream into which it is discharged.

(2) The second proviso of the resolution was to assure that all impoundment basins and other control methods shall be operated in accordance with schedules to be formulated to insure appropriate ratios between chlorides and stream flow.

I might say at this stage the appropriate ratio between chlorides and stream flow is to use the ratio that we can demonstrate at Saltville. We do not have control over the flows below that point and, therefore, we are somewhat limited in having significant control over the amount of chloride at points further down the river.

In 1958, Charles T. Main, Consulting Engineers, were retained by the company to make technical studies and recommendations in connection with the effluent problem. A comprehensive statistical study was made to determine the volume of lagoon capacity required to meet the Virginia State Water Control Board requirements. The maximum level at which plant effluent could be maintained was investigated as was the stability and strength of the dam. The structural investigation was made by Moran, Proctor, Maeser and Rutledge, Consulting Engineers. The study indicated that the height of the liquid level in the pond could be raised approximately 10 feet by increasing the height of the dam a corresponding amount provided that by doing so, seepage was not materially increased. The additional height, 1-1/2 ft/year, makes it possible to reduce the maximum chloride concentration from 5,000 p.p.m. to 4,500 p.p.m. by 1963.

The Harza Engineering Company of Chicago was retained to make an extensive study of the Saltville disposal problem. A final report of their survey was submitted as of January 6, 1961.

After consideration of all the factors involved, a recommendation was made that a 50 acre tract immediately west and downstream from the present dam structure be obtained. It was proposed to construct a 30 foot dyke approximately 4,500 feet long. The estimated cost of the project is approximately $1,000,000 and includes land purchase, river and highway relocation, pumps, and piping. We are pleased to report that management appropriated the necessary funds for the project on April 26 and that land acquisitions and engineering are proceeding according to plan.

It is proposed to use the area primarily for the retention of solids. The total waste liquor including solids would be pumped from the plant directly into the new impoundment area. The solids will settle out and the clear liquor will be drained and repumped to the present impoundment area and released in regulated amounts according to stream flow. The structure will have an estimated life of fifty years.

Although we take no issue with Mr. Deutsch's remarks or tabulated values regarding flow requirements to keep chloride contamination within tolerance levels known to be suitable for irrigation purposes, we feel no comments are indicated since to the best of our knowledge neither the North Fork nor the Holston Rivers are used to irrigate crops.

3. Sale of Ammonium Chloride

The sale of ammonium chloride as a possible solution to the discharge of high chloride concentrations from the ammonia soda process is a potential which has received its just consideration. The matter has not only been investigated by Olin Mathieson, but has been researched by the whole industry. One of the large soda ash producing companies has sponsored research grant-in-aid studies at Cornell University, Ohio State, Penn State, Michigan State and Purdue.

The conferees will be pleased to learn that Olin Mathieson investigated this possibility many years ago and has supplemented its investigation with a sponsored grant-in-aid research project in 1951 at the University of Arkansas. Studies were made using ammonium chloride on cotton, corn and rice. The results obtained were not conclusive for corn and cotton. With rice it was noted that ammonium chloride was as effective and in some cases slightly more effective as a source of nitrogen.

The Cornell field studies of 1958-59 made on corn, concluded that corn yields per pound of applied nitrogen were low but as good from ammonium chloride as from ammonium nitrate. The significance and importance of the nitrogen fertilizer experiments with corn which yielded a maximum of 82.5 bushels/acre with 60 pounds of fertilizer nitrogen/acre can be questioned. In corn country, 100 bushels/acre yield requires a minimum of 150 pounds of nitrogen/acre while 150 bushels/acre yields require a minimum of 225 pounds of nitrogen.

The Cornell researchers reported that high amounts of chloride may delay maturity of corn. Corn subjected to high amounts of chlorides in the experiments tasseled and silked later than that which had not received chloride. It was concluded that the delay in maturity could reduce yields if the crop were subjected to unfavorable conditions late in the season. The delay in crop maturity by using amonium chloride is a very important factor since the effect of the chloride ion would undoubtedly be associated with either retarded maturity or a decrease in crop yield. Its use or acceptance would have to be resolved by farmer reaction. To say that it would result in a controversial issue would be stating it mildly. However, it does corroborate Mr. Deutsch's statement that the only high volume market for ammonium chloride is in the fertilizer field and the farmer's acceptance of this salt as a fertilizer proceeds very slowly notwithstanding its high nitrogen content.

The University of Arkansas studies indicated no significant difference in rice yields when ammonium chloride was used as compared with ammonium nitrate or ammonium sulfate. The studies confirmed the Japanese findings. The use of ammonium chloride is steadily increasing in Japan because the Japanese are primarily rice eaters. Rice is grown on flooded soil which comprises 90-95 per cent of the total rice crop in Japan. Fertilization with ammonium chloride can be practiced since the cumulative effect of the chloride ion is not encountered due to its solubility. Mr. Deutsch suggests that consideration be given to the ammonium chloride process at those alkali sites where the prevailing climate and crops lend themselves to the use of ammonium chloride as a fertilizer. Technically, the potential for its use would be in the rice crop states of Arkansas, Louisiana, Texas and California.

A prerequisite for the production of ammonium chloride as pointed out by Mr. Deutsch is the necessity to be located adjacent to a profitable ammonia synthesis operation. This prerequisite, unfortunately, does not exist at Saltville nor is it in the realm of possibility for its existence due to economics of construction. A basic consideration which negates the use of ammonium chloride as a potential pollution abatement project is the relative cost and availability of nitrogen in the following forms:

Type of NH_3	Cost of Nitrogen, cents/lb.
Anhydrous ammonia	5.63
Ammonia solutions	6.30
Ammonium sulfate	7.62
Ammonium nitrate	9.55
Ammonium chloride	9.80

Another economic factor which must receive consideration is the fact that approximately 300,000 tons/year of ammonium sulfate will become available by January 1964 as a by-product from the production of caprolactum.

Nothwithstanding the obvious disadvantages connected with the sale of ammonium chloride, Olin has made a thorough investigation of the possibilities of constructing a plant to manufacture ammonium chloride. As a result of economic studies of plant construction and operating costs at Saltville, we have determined that it would not be economically feasible to enter the limited ammonium chloride market in the Saltville area.

4. Sale of Calcium Chloride

After reading Mr. Deutsch's comments on the sale of calcium chloride, we gather he does not entertain much hope that the production of calcium chloride from ammonia-soda plant distiller waste is going to solve the problem notwithstanding the fact that by-product calcium chloride is produced and marketed by two ammonia-soda manufactueres.

Olin concurs with this viewpoint since it has studied this phase of the problem many times over the past 30 years. The latest study was made at the request of the Virginia Water Control Board in 1956. As a result of a market research survey, it was determined that the total available calcium chloride which could be produced from recovery from ammonia-soda plants was 6,000,000 tons/year. The total calcium chloride consumption is 10 per cent or 600,000 tons/year. It was estimated that the Saltville plant would possibly serve 10 per cent of the total U. S. calcium chloride market and with additional freight equalization, possibly 15 per cent represents 100,000 tons/year or approximately 20 per cent of the total available calcium chloride when operating the plant at 1000 ton/day rate. If Olin were successful in obtaining all of the southeast calcium chloride competitive market, the chloride reduction would be exceedingly small, only 15 per cent.

If all the calcium chloride were recovered from all the ammonia-soda plants in the country, one medium size plant could supply the entire U. S. market. Mr. Deutsch reports that the total amount of calcium chloride which can be marketed even at marginal profits, represents well below 5 per cent of the initial alkali industry waste volume and furthermore it must be sold locally since it cannot carry a high freight rate.

The principal consumption of calcium chloride is for deicing of highways and roads (57 per cent) hence most of the tonnage is consumed in the northeastern part of the country on a seasonal basis. Competitive producing plants are at Midland, Michigan (Dow Chemical); Barberton, Ohio (Pittsburgh Plate Glass, Chemical Division); and Syracuse, New York (Solvay Process Division, Allied Chemical).

A similar market analysis of the problem was made by the Chemical Salts Industry Committee organized to cooperate with the Ohio River Valley Sanitation Commission. It is of interest to note that their survey indicated 50 per cent of the commodity calcium chloride demand was centered in Pennsylvania, Michigan, Illinois, Ohio, Minnesota, and Wisconsin. States south of the Ohio River, including Texas, Arkansas, and Oklahoma represent about 15 per cent; the New England states about 10 per cent; and the remaining 25 per cent to the unnamed states. The committee concluded:

1. The available calcium chloride far exceeds the demand.

2. There are no new developments and the present market is not expanding. (The Calcium Chloride Institute has been constantly exploring for additional uses for many years.)

3. The market in the south is very small and potentially unattractive.

4. Existing northern markets appear to be adequately served by present producers.

5. Markets available to a producer in the Ohio River Valley represent not more than 25 per cent of the total.

5. Underground Brine Disposal Wells

The underground or deep well disposal technique is a potential method of industrial waste disposal which is highly overrated as a practical method of waste disposal in the chemical industry. Mr. Deutsch, we believe, will agree with this opinion since he states that to the best of his knowledge, subsurface disposal wells are not used by an alkali factory anywhere in the world, hence the method can only be discussed on a theoretical basis. Mr. Deutsch is apparently aware of the shortcomings of this method since he makes no claims for its success other than its ideal application in certain oil fields where only soluble sodium brines are encountered.

We would like to call attention to the fact that the ammonia still blow-off liquors contain calcium chloride, calcium sulfate, calcium carbonate, and calcium hydroxide, all of which are prone to form insoluble precipitates which can cause plugging of the sands and seriously diminish the useful life of the well. The alkaline-earth salts are well known for their chemical incompatibility between formation brines even though the reactions may require considerable time for completion with increased temperatures and pressures encountered in subsurface formations. We concur wholeheartedly with the premise that deep well disposal has very little promise except at selective, favorable locations and we might add when volumes required to be handled are relatively small, up to perhaps one or two hundred gallons per minute, not 1600 g.p.m. as exists at Saltville.

The question of subsurface disposal of the plant effluent was first raised in 1952 by the Virginia State Water Control Board. Even though Saltville held no optimism for the disposal of the brine by deep well injection, a consultant geologist was engaged to investigate the possibility of disposing of the chloride wastes in this manner. Sufficient test drilling and coring of the strata has been done to clearly demonstrate the complete lack of sedimentary rocks with the appreciable porosity and intergranular permeability among the bedrock exposed in the Saltville area. The shales, siltstones, and sandstones, all reveal negligible porosity and extremely low fluid permeability. Permeabilities on the order of .00295 millidarcies have been determined. Dow Services, Inc. who have done considerable deep well drilling for chemical waste disposal, claim that a permeability of at least 1000 millidarcies is necessary for successful fluid passage.

On August 15, 1960, Mr. Kittrell, accompanied by Mr. Latta, a geologist employed by the Kansas State Board of Health, visited Saltville to review plant records and to discuss the possibilities of constructing a deep well. Since nothing further was heard regarding the meeting, it is assumed the conclusions reached, if any, coincide with the Saltville findings that underground disposal of the plant effluent, due to the geological structure and geologic evidence gained, is not practical.

6. Improved Salt Utilization Efficiency

There is little technically or process-wise that can be added to Mr. Deutsch's remarks regarding the improvement of salt utilization efficiency. The Saltville plant is currently operating at the upper range of values which Mr. Deutsch quotes as being typical for the industry. Tower decompositions have been improved and are constantly scrutinized to insure maxium decomposition which in turn decreases wastes to the stream. It has been the practice at Saltville for many years to search for more efficient use of salt in the ammonia soda and chlorine process. In the last six years, positive steps have been taken with our day to day "chemical housekeeping" and special attention has been given to minimizing chloride discharges.

The solids which are formed during brine purification are washed and filtered to prevent sodium chloride contamination solids from going to waste. Most of the salt which is taken from the brine wells passes through the ammonia soda process for effective conversion to ammonia soda products.

As a result of improvement in impounding technique and a general tightening of in-plant procedures, chlorides have been reduced from 8,000 p.p.m. in 1958 to 5,000 p.p.m. in 1960 and will be reduced to an expected level of 4,500 p.p.m. by 1963. All effluents from the plant and the receiving stream are continuously checked on a 24 hour basis for the purpose of controlling chloride contamination. Little further can be done at the present state of the art in improving salt utilization efficiency.

Similar action is taken with the limestone mined. All stone mined with the exception of slaker rejects is effectively used in the process. Process economy and pollution control equally dictate that this course of action be followed.

7. Other Processes for Ammonia Regeneration

The suggestions outlined by Mr. Deutsch, while technically conceivable, are too theoretical for commercial application. Mr. Deutsch's observations and conclusions are significant in themselves especially when he makes note of the fact that even though some of the proposals have received a reasonable amount of research investigation they did not show any promise with prevailing economic conditions which currently exist in the chemical industry.

Mr. Deutsch cited two possible alternatives to the liming process for ammonia recovery: (1) the conversion of manganese chloride and the subsequent oxidation for chlorine release and (2) the use of dilute caustic from electrolytic cells for the regeneration of ammonium chloride. There would be little motivation in adopting Mr. Deutsch's suggestion on the use of electrolytic caustic soda and flue gas even to the limited extent of 15 to 20 per cent of plant capacity. The overall effect of using dilute caustic soda from electrolytic cells for ammonium chloride regeneration would have serious economic effects as mentioned by Mr. Deutsch. In addition to curtailing production of ammonia soda with a consequent rise in unit production costs and the elimination of a supply of CO_2 which is used for other purposes, it has a profound effect upon the balance of the co-products, caustic and chlorine, which were discussed under hearing No. 1. The Saltville plant as well as the Division's Research and Development Department have considered and rejected the proposals made by Mr. Deutsch for the same reasons.

Olin has considered other methods in the past and as a matter of policy will continue to pursue this approach as new ideas are projected either by Olin or by others. In addition to Mr. Deutsch's suggestion, we have given consideration to (1) recovery of ammonium chloride and thermal decomposition to ammonia (for recycle) and hydrogen chloride (2) recovery of ammonium chloride and use in organic or inorganic reactions to yield ammonia (for recycle) and organic or inorganic chlorine-containing compounds.

Some consideration has been given to a process conception recently proposed by Arthur D. Little Associates. Rather extensive discussions were held which resulted in some questions put to Arthur D. Little who will pursue the matter more fully prior to evaluating their proposal. Although the proposal was primarily in its conceptual stage, we are of the opinion there are technical as well as some nontechnical problems which cast some doubt on its overall feasibility.

Unfortunately, all the proposals made have one common flaw. The stoichiometry of the ammonia soda process is

$$2NaCl + CaCO_3 = Na_2CO_3 + CaCl_2$$

The carbonate anion is made available from the limestone which, in turn, provides the calcium for combination with the chloride ion. If any other fate is selected for the chloride ion, the limestone source for carbonate ion is eliminated. There is no other practical chemistry which will provide a convenient source of carbonate ion and an economic or innocuous fate for the chloride ion.

8. Pipeline Disposal

There have been mixed opinions regarding suggestion No. 8, principally as to its sincerity. Mr. Deutsch's statement to the effect that the investment cost of 100-200 miles of pipeline and maintenance costs would be more than "substantial" in our opinion is a gross understatement. However, in deference to his preceding seven suggestions, we admit that no consideration has been given to the construction of a 200 mile pipeline because it is considered impractical. An 8-inch steel welded pipe in place would cost approximately $8,000,000.

Other Considerations

In addition to Mr. Deutsch's foregoing suggestions, Olin has, subsequent to the first Kingsport conference, investigated other methods for possible chloride reduction. Desalinization by ionic membranes and solvent-solids separation using a freezing technique were tried. A study of the latter was made in the laboratories of Roy F. Weston, Inc. It was reported that freeze-out does not appear to be attractive due to complexities of the physical chemistry involved. The present state of the art in both instances precludes their consideration due to unfavorable economic circumstances and the fact that both processes only tend to concentrate the salts which still require handling. Little hopes for a complete solution to the problem is seen for either of these methods.

After a thorough, complete review of existing and potential treatment methods for a possible chloride reduction, we are convinced beyond a doubt that there is no ready alternative method of disposal of soda-alkali effluents other than that which is practiced by the industry and currently in effect at Saltville -- that of solids separation and disposal by dilution, utilizing regulated discharge where and when deemed necessary.

We can say with conviction that we, as do the Virginia and Tennessee Control Boards, hope that some day a solution will be found whereby inorganic wastes can be treated in a practical manner with due reasonableness given to the economic feasibility. The technology at our command does not allow us to make such a claim now and probably not in the immediate future notwithstanding our extreme desire to do so. We, at Olin, are of the opinion that we have and are currently in the process of taking the necessary action reasonably calculated to minimize the effects of the Saltville effluent upon the receiving stream.

CHAIRMAN STEIN: Thank you.

Are there any comments or questions?

MR. WALKER: I would like to ask Mr. Paessler, our Executive Secretary, if he has any comments. We have Mr. Paessler, Mr. Davis and two assistants of our staff here.

MR. A. H. PAESSLER: I don't believe so.

MR. WALKER: I would like to say this. In July 1946 when our law became effective and I was appointed on the Water Control Board, I had some of the optimism that Mr. Wolfe has expressed.

I would like to say furthermore in the interim the Saltville problem has been one of our worst in Virginia. A constant effort has been made to bring about abatement of that problem. Much has been accomplished by the industry as a result of the cooperation, as a result of orders that have been issued by our board to control the flow of these wastes, and we hope the problem of breaks and spills has been eliminated. It was one of the greatest problems in the earlier years.

Under our water control law, as I think I stated in the first conference, the board has very wide authority to issue orders on industries, but they must be reasonable, and any order that we issue would be construed by the courts.

Actually we don't know the solution other than to order the wastes to be discontinued, which would mean shutting down the plant.

We have, as I have said, reduced the maximum discharge of wastes to a point which the industry has convinced us on the board that it is the maximum that they can go to and still operate.

God knows there is no one more conscious than I of the unsatisfactory condition of the North Fork of the Holston River in Virginia and more conscious than I of the problem that it involves in east Tennessee. I hate to think, as Mr. Wolfe says, that it is a Hobson's choice, but I know the problem can only be solved by the technicians. If there are solutions to be found, the Public Health Service, the U. S. Public Health Service is helping to find those solutions. I hope they will be found. Frankly, I don't see it in the immediate future. It isn't a satisfactory situation for our board to sit there and say, "Here is a condition we don't like," but the practical side of it is we just don't know anything that we can do at this time to alleviate it. I think we can leave it there.

CHAIRMAN STEIN: Any further questions or comments?

DR. FLANNERY: I would like to correct a possible impression I left with Olin Mathieson. Certainly my remarks did not age the contribution that Olin Mathieson made to the economy. This does not mean that I disregard them. In any economic operation there are adverse and favorable occurrences. I was looking at the adverse effects of the water quality in Tennessee. I thought the Olin Mathieson's contribution here is almost self-evident contribution to the economy.

In regard to the volume of flow of the streams, certainly I am not a hydrologist and no pretention of that kind of theology.

It is somewhat evident here that small companies are the ones -- that is have 50 to 250 employment -- who are going to use water and would have to incur some treatment because of quality conditions. These are the ones where treatment cost would be more serious. They would be more affected by it.

Now the glass company, American Saint Gobain, my remarks there, I repeat that it is quite probable that they offset the water treatment cost they have incurred by the gains they obtain in management skills by their sister division right close by. This is not conclusive perhaps to either one, but it is a noteworthy thing.

The Olin Mathieson is spending this additional one million dollars to buy a new "pot". This is significant and it is certainly an excellent acknowledgment here of the public interest, that this is a pollution and it is a tough economic problem and it is not solely an economic problem. I have no solution here. It indicates that adjustments can be made both ways. Thank you.

CHAIRMAN STEIN: Thank you, Dr. Flannery.

I wonder if you could tell us possibly a little more particularly. Mr. Logan, when this dam can be ready for operation other than next year? Can you give a more specific date?

MR. LOGAN: I will defer to Mr. Aebersold of the Saltville plant.

When do you expect it ready for operation?

MR. R. C. AEBERSOLD: It should be ready shortly after the first of the year.

CHAIRMAN STEIN: Shortly after January 1st?

MR. AEBERSOLD: Yes.

CHAIRMAN STEIN: We won't have to wait the full year.

MR. L. W. ROZNOY: The engineering is proceeding at the moment.

I would like to make one point in connection with your statement, Mr. Stein, and that is the engineering is already proceeding on this particular job.

CHAIRMAN STEIN: We are asking for when it will be completed and in operation. That will be shortly after January 1, 1963. Now will this dam reduce chlorides in the river?

MR. ROZNOY: It will assist in the leveling out of the chlorides. You won't get the peaks that you have experienced previously. They will be at a minimum. Of course, that will be in the North Fork of the Holston River only. As Mr. Logan mentioned before, we have no control over the regulated flows from the TVA dams.

CHAIRMAN STEIN: Have you gotten the permit for this dam from the Virginia Water Board or is that required? I am thinking in terms of spills.

MR. WALKER: Mr. Paessler, would you comment?

MR. PAESSLER: Under the water control law -- this is an existing industry -- specifically since this would be an improvement in a situation, this State Water Control Board does not have to approve the plans for the improved operation. Customarily, industries submit these plans to the board for its review, and except for the generalities of the situation on an informal basis with the staff, there has been no official submission of the plans to the board.

CHAIRMAN STEIN: You haven't looked at the specific details?

MR. PAESSLER: No.

CHAIRMAN STEIN: In other words, you cannot say you are satisfied that this is a structure that won't have breaks? I am sure if Olin Mathieson is going to put this in, that they won't design it that way.

MR. PAESSLER: I am satisfied that what they propose to do will be as they have represented it, but I have not reviewed the plans.

MR. C. C. HIGHTOWER: Might I point out that the plans of the engineering are not yet complete. After the completion of the engineering, then we can submit those.

CHAIRMAN STEIN: All right. I don't want that to be an implication here that we would think Olin Mathieson or any other company would put an impoundment in which is going to leak or break. But generally speaking, it is always safer to have an outside group such as the state regulatory agency to look at that.

MR. PAESSLER: Let me say right there in reference to this, that we will not concern ourselves with the strength of these dams. Olin Mathieson and its engineers are responsible for that. We feel if they have competent engineering on that, this is their responsibility. If we review these plans, it will be only from the standpoint that the regulation and the discharges and so forth will accomplish the stream improvement and the stream quality that they say it will, and the details of the engineering and so forth is not our responsibility. Unless our board directs us to do so, our staff does not propose to make any detailed review of the engineering features. This is not our responsibility.

CHAIRMAN STEIN: We are glad to have that, Mr. Paessler.

Do you have a question?

MR. THOMAN: I have one question, Mr. Logan. In going through the list of suggestions that Mr. Deutsch prepared in his report and the rejection of those for one reason or another, at any point have you considered combinations of the various things? For instance, while the production of calcium chloride won't completely mitigate the situation, it certainly would help. Possibly that combined with some of these desalinization things becomes economically feasible.

What I am trying to drive at, have you reviewed these on an individual basis and then rejected them on an individual basis or have you combined two or three of them to see what the economics would be under those situations?

MR. LOGAN: Let me say, first, that we have not in our comments rejected Mr. Deutsch's suggestions. I think he made a series of suggestions regarding alternate possibilities, and in most respects we agree rather closely with his evaluation of the various alternates. We did not reject his suggestions.

With respect to the second part of the question, this has been a continuing examination of the various alternates, and you are quite right that circumstances do change from time to time. We have repeatedly kept, for example, the calcium chloride review at hand so that at any time we saw another part that would add to it and make sense, we would at least know what contribution calcium chloride could make to the total picture. We have not formerly assembled a composite package of alternates that might help the situation, because the economics that apply to the individual components are not substantially altered when you put the package together, and this is a part of the problem, that no one of these has been economically sound in its own right, and, therefore, to add two or three economically unsound alternates doesn't make the total economically attractive.

MR. WALKER: I would like to make this comment on this new impoundment. It is my understanding -- I think we all ought to keep clearly in mind, it is not a reduction or waste in any sense. It is a further aid toward minimizing the maximum flow.

MR. LOGAN: Correct.

MR. WALKER: Much has been done along that line, and if they did not, they would soon run out of space where they are. It is not a solution to the problem, except to make it a little more livable. I think we all ought to recognize that.

Now the solution of the problem seems to me either water in-plant process or one of a market for by-product. That is purely technical.

I think if Dr. Deutsch has any conflict with what has been said here, I would like to know about it, because there is our problem. We either have got to find by-products or we have got to find some method of making the product by something that avoids those wastes, or we have got to discontinue operations, if this thing is going to be fully corrected. We might just as well recognize it here. No use trying to sweep it under the carpet.

CHAIRMAN STEIN: Dr. Deutsch, do you feel you want to comment since Mr. Logan used your report as a point of departure? You may want to comment.

DR. Z. G. DEUTSCH: I have no comment to make, except I feel very flattered. He says he agrees with me on most points. I think the only possible point of disagreement would be what I wrote then and what he has reported now on this last most absurb point, the pipeline downstream, where I said the power wouldn't be very significant and he says it will be. That doesn't make any difference -- we talk about a crazy idea. It doesn't matter what it is crazy for. (Laughter)

CHAIRMAN STEIN: As I understand it, Dr. Deutsch, you thought that ammonium chloride process did have some --

DR. DEUTSCH: I did this for the alkali industry as a general thing. One thing I think ought to be understood. My report was written for your office in discussing the alkali industry in general, not at the Saltville plant in particular. I kept stressing the fact that local or indealized locations would make it this or that or the other, good or bad, as the case may be. I think the best thing now would be to give me time to study what the Olin Mathieson people, what Mr. Logan has submitted and prepare a formal comment.

As I listened, I think he and I are in full agreement.

CHAIRMAN STEIN: All right. Thank you very much.

Mr. Paessler.

MR. PAESSLER: I think I would like to make two comments here. The first involves possible in-plant reductions, either by change or improvement in process or making of by-product, either one. This has got to be a significant deduction in order to effect any change, any appreciable change in water quality at the Virginia-Tennessee line.

In other words, it has got to be almost a total take out of the amount of waste that now goes in for the simple reason that the amount of water at Saltville is so limited.

The second thing in connection with the proposed ponding improvements that are underway at this time, I would like to say that this has been into discussion by the company with our board for some time, and inasmuch as there were certain considerations involved, I guess this is really the first time it has ever been made totally public. This is something that the staff and the board have discussed with the company over a long period of time and we are glad to see it as a further control measure.

CHAIRMAN STEIN: Thank you. I think we should take cognizance of the fact that Olin Mathieson is contemplating a very large expenditure and I do think, I thoroughly agree with everything that Mr. Walker said. This is not going to alleviate the solids or the salts. We have to work at this realistically. If we can eliminate the peaks, we may have a solution to the problem. I think we recognize it and recognize that the Olin-Mathieson Company is approaching this in a method looking within the terms of solutions to alleviate the problem.

However, I do think that we have a question here that Mr. Wolfe raised, and I would indicate to you that I think that is a prevalent opinion.

You know, Mr. Wolfe is a lawyer from the southwestern part of the state, and I am as far up northwest in Virginia as you can get, and I hear the same comment. This isn't something unusual.

I think we might just outline the two points. I think realistically Mr. Walker pointed out this problem that we have to face. I think, one, there is no doubt that we do have a technical situation requiring a technical solution. The technicians are the only ones that can give us the solution. However, there are certain assumptions. Every assumption made as to the effect of this as to waste treatment process, and I am not arguing this, is the fact that this type of process has to show a profit for the company, whatever it is Olin Mathieson or any other company. Most cities treat that as a loss. They don't make a profit. A lot of industries treat waste and don't expect to make a profit. They figure waste treatment as a cost of production.

There is a question here, or a question does come up -- if any of these methods or a combination of these methods can be used which will not accrue as a profit to the company, but can be reasonably considered as a cost of waste treatment to stay in business. Olin-Mathieson is putting out a million dollars for a new lagoon. Obviously they are not expecting to make a profit on that new lagoon. They recognize that expenditures are to be made for waste treatment which don't necessarily reflect themselves in profit.

Then we have the second point. I think at the end of your talk, Mr. Logan, you put it very nicely, and I think Mr. Walker put this thing very delicately, that within these limits, we don't find the solution. Here we come up with the problem.

I think this is probably put more boldly by the National Technical Task Committee. They say, and I am quoting here:

"It is evident from the foregoing presentation that there is no ready alternative to present methods of disposal of soda-alkali industry wastes. Considering the industry as a whole, however, there is no reason to believe that existing disposal methods pose a serious pollution problem. Where these wastes are necessarily discharged to smaller water systems, ponding and controlled discharge have proven to be effective control measures satisfactory to the state authorities involved."

We do have discharges here into a small or relatively small watershed. Ponding and control measures evidently have not been completely satisfactory to the state authorities involved.

Then it says:

"During the industry's history, extensive research has failed to find an alternate practicable method of waste disposal." And there's the key. "At present, industry is unable to recommend or envision any research program offering any hope of success."

Now given the situation, in the face of the situation like that, and the fact that Mr. Wolfe is living in Virginia, as a Virginian and I am living here, and I have bosses to face, who face that. They do not seem to want to accept that kind of an outlook that at present industry is unable to recommend or envision any research program offering any hope of success.

Now under our law, at least, the Federal law, and under the process of arriving at the truth in our system of government, the problem of getting at that, if we are faced with that kind of problem, we may be faced with the situation of dealing with material presented under oath and subject to cross examination.

Now I believe in pollution control cases this is not desirable. I believe we should do everything we could to avoid that. However, taking an answer back like this to the people at large, the people of possibly the two states or the people who are representatives in Washington, taking back a solution like this, and ask how we have arrived at this, that we have not gone through this traditional process of taking testimony under oath or cross examination, I am not sure that this kind of answer will be acceptable. I am asking you just to sit with me and try to think of how we can arrive at an operation or a mode of approach to this problem which possibly can avoid that and yet not force us to go back with an answer like this.

MR. ROZNOY: I would like to make a statement in response to that, although I don't think I have an exact answer that you are looking for, Mr. Stein, but I will say this. It was my pleasure to sit in a meeting with scientists from the Public Health Service who work out of the Taft Center in Cincinnati, Ohio, and wherein this report was pretty much formulated and discussed, and it was the consensus of all concerned, I might say including the Public Health Service top level scientists in Cincinnati, the Taft Center, that there is no known method available.

As far as the possibility of setting up a research project, we couldn't even come up with a possible solution or even a program wherein we might possibly further the solution of this problem through research. As a matter of fact, the head of one of the departments at the Taft Center, at the conclusion of our meeting, said rather facetiously, "Well, the only possible way that we can get rid of these wastes are to put them in orbit!" And that is the way the meeting terminated.

As I say, it was the consensus of your top industry and the Public Health Service and scientists. So an effort has been made to come up with a research solution to this problem, and it just turned out to be negative.

CHAIRMAN STEIN: The difficulty we have, and just face this, if we go back to Washington to the Congress and the representatives and the committees, we have to go before, the secretaries and assistant secretaries, and we tell them that there is no research answer to that and they say, "Here we are about to put a man on the moon and you people have no possible lead, you can't envision any research that can solve this problem!"

This is a pretty difficult report that you are asking me to bring back and try to sell to the people back there. I don't know what kind of reception we are going to get if we come back with something like that.

MR. LOGAN: Mr. Chairman, I think from your reading of the report of the Task Force Committee, which included a rather broad sampling of people, it as staged that at the moment they have no answer in hand. Now I will agree with Mr. Walker. I don't agree with Mr. Roznoy, who works for me and, therefore, I can disagree with him, that this means the answer will not show up. I am hopeful that the answer will.

We, as a corporation, spend a great deal of money on research, and if we are successful in one project out of 25, why you have had a fairly high batting average. So conceivable, the answer will show up.

It seems to me that this calls for additional effort in that area, admittedly with no present vision of what the answer is going to be, and, second, an immediate increasing, if that is possible, of the cooperative effort between the agencies involved here, because we have an unusual problem on the Holston that the national average does not necessarily apply to, and we certainly are willing to extend and increase our cooperative effort with the state authorities and with the communities along the river in an attempt to make the best of the situation while we hopefully look to research to come up with the answer.

MR. WALKER: Mr. Chairman, may I make two or three widely separated comments?

Going back, the State Water Control Board of Virginia certainly doesn't object causing Olin Mathieson to spend some money. If it were a matter of spending money to correct this thing and still operate, it would be only one answer in our standpoint.

What Mr. Paessler said is perfectly true, the minor reduction in waste isn't going to solve your problem. You are dealing here with an inorganic waste, I think you term it, and something that you can't change by treatment. It is there and it is going to be somewhere. You can impound it or whatever you please. You may divert it, if it is possible, but it is there. It is not changing.

Now the other thing, the question from your standpoint, Mr. Chairman, you know your problems in Washington and we are not complaining, the State of Tennessee is not complaining, but I would like to know in God's name how you can prove anything more by testimony under oath than you can from testimony at a meeting like this?

In other words, a formal hearing under oath, what difference does that make? All you do is just take a lot of people's time. You must have 50 or a hundred people here, and their time is worth something; and to go through a series of formal hearings under oath, I don't see how anyone here is going to give you any different testimony under oath than today.

CHAIRMAN STEIN: I am not suggesting that. By the way, the determination to do that is the Secretary's and not mine. I don't think, and maybe Mr. Thoman will join me on this, I don't know on the basis of what we have heard at the two conferences and the meeting that we can say -- and go back with a definitive statement and say that we are satisfied, at least the Federal representatives are satisfied on the basis of the given knowledge that this impoundment is the only thing that possibly can be done and that the Olin Mathieson Company or the rest of the alkali industry should not have a more positive program leading to a hopeful solution.

The point is, we don't have that, and I am not sure a type of program like that should not be in the offing, that we could. This isn't just for the people in Washington but for the American people as a whole, particularly the people of Virginia and Tennessee.

MR. WALKER: I would like to make a further comment. Mr. Roznoy, this is just throwing something in the air. Doesn't it seem to you that where research might accomplish something is trying to find a market for your by-product? Isn't there some useful purpose to which this product could be put, something that can be made of it, used in some manner? I know there is an awful lot of salt in the world.

MR. ROZNOY: Especially salt, Mr. Walker.

CHAIRMAN STEIN: What impresses me about Mr. Deutsch's point and one with which I thoroughly agree, one we discussed with Mr. Deutsch, and if I misstate it maybe Mr. Deutsch can get up. In discussing this ammonium chloride process as a fertilizer or anything else, it comes up time and time again that there is no market for the product, not that you are not putting out a useful product.

Now the next point you come to, if the solution here is an aggressive sales campaign or creating a demand for a product, wouldn't that be a possible approach to this problem? What you are doing is putting out useful products for which there may not be an immediate market in the Saltville area.

MR. LOGAN: I would like to comment on that, Mr. Stein, as well as on Mr. Walker's comment. I referred to certain agronomic studies and I left it at that for two reasons. We didn't want to get anybody's hopes up that we have any solution until we have substantially more evidence, and, secondly, obviously if it is a good idea, we would like to keep it confined to the Saltville area so we can get the maximum benefit from it.

There are certain tests that we are running this growing season in certain areas, not immediate to the Saltville plant, but within what we believe to be practical disposal distances, that may -- and I emphasize "may", because we are not at all certain that they will -- that may produce some interesting results, in which we would hope that this waste material as it comes out of the plant could be moved reasonable distances and find disposal on some basis that is practical.

Now this is far from being an assured success. It may never be a success, and, therefore, we don't want to hold it up as such.

CHAIRMAN STEIN: Right. I understand and I am not suggesting this. I understand the competitive situation and that you may want to develop this on your own without a disclosure. This we recognize and this is certainly your privilege. But I do think from the standpoint of the public agencies, if in any sense this were not the case, that a disclosure of this avenue of work would be more helpful in the Federal agencies certainly and very possibly to state agencies in coming to a conclusion of a time schedule and working at that. And if, on the other hand, there were a public disclosure, and I am not suggesting -- this may be against your company policy again -- if there could be a public disclosure, this is the kind of thing that the Federal Government at least might be very, very interested in supporting through its research process in working right with you.

MR. LOGAN: I think some time this fall, at the conclusion of this 1962 growing season, and after data is back and has been analyzed, it would be possible for us to make available to the conferees the results of those tests, whether they are good, bad or indifferent. I think we can do that and would be happy to.

MR. WALKER: I think that is in the right direction. Of course, you have got something there in the way of waste. You can't manufacture a product without it.

DR. HUTCHESON: Mr. Stein, I don't want to prolong this any longer, but I do want to make a comment about the statement you made here on hearings under oath. I will have to agree with Mr. Walker on this, that I don't think there is any advantage whatever, and I can see some disadvantages would come from that. Some of these statements that you have got have been made by your own staff or employees of Health, Education and Welfare. Certainly I think they will believe theirs, and they correspond very closely with those that have been made by others.

I think it would be a waste -- I know it would be a waste of my time and the Stream Pollution Control Board in Virginia and Olin Mathieson and your own time, if I may say it, to anticipate a thing like that. I think that you are overlooking, when you put any hope on this fertilizer business, you are overlooking the fact all you are going to do is get the chlorine out and you have still got your sodium and your calcium. If you pile it up on the ground somewhere, it is going to wash into the river.

I don't want any of you to get the impression that I am getting soft on this. I think that what we want to do and what Olin Mathieson must do, along with other industries, and I think with the service itself, I think that the Public Health Service and its facilities have an obligation that they haven't discharged in the field of research. When this thing first started, I had hopes, and I am still not completely sold, that there might be some possibility of underground storage of this. I didn't know that they had gone as deep as they have gone in looking for solution to it. It can be improved, and I think with the damming and impounding, rather, lagooning of the waste and a uniform release, certainly the industries will be in a better position to know what they have got to treat than they will if they are shooting these peaks that come down the river from day to day.

I think that Mr. Logan said something about the outlets from the lagoon were not such that they could let it out. Those would be simple to change, wouldn't they, Mr. Logan?

MR. LOGAN: I think so, yes.

DR. HUTCHESON: With a cooperative effort on this, I am willing to go along and work with them and try to get anything that will give us improvement.

CHAIRMAN STEIN: Thank you very much, Dr. Hutcheson.

I think what I did was, I gave a legal formulation. I didn't mean that people weren't telling the truth.

DR. HUTCHESON: We are dealing with chemistry instead of law.

CHAIRMAN STEIN: The difference here was the cross examination technique and not the implication that obviously you haven't had an opportunity or Olin Mathieson to question our people, or Mr. Deutsch or our technical experts, that this was the only thought we had on that. The problem though, and I think that this is a problem, there is a statutory procedure set up and what you say, I might tend to agree with you, that we have explored this situation as far as we can and as productively as we can here. We might not be able to go further or come up with anything else, if the procedure goes any further.

This determination, of course, will have to be made by someone else. Under our Statute it is the Secretary and the Secretary particularly in something of this importance will do this personally.

I might say, Dr. Hutcheson, I agree with you on this underground problem. We thought of that and I know Olin Mathieson did. As a matter of fact, we hired the best geologist we could find from outside this area so we would have what we thought would be an objective view and had him come in and look into this question of underground storage before we had the first conference. This is something that we did explore.

Again, and I would like to point out, I agree with you thoroughly, Dr. Hutcheson, on this research. We do have this kind of a problem with research. In dealing with an industry, there is always a public question on how much of public funds should go into research in dealing with research on an industrial product.

Now I think just speaking generally, this is more apt to happen when industry comes forward with a proposal and makes a disclosure, because what you do run into in various places, industry is doing research, and in many cases very properly considers the result of this research is going to accrue to its competitive advantage.

I think the service stands ready to cooperate with industry. But this has to be something that industry has to cooperate with us on, too. In many areas, for good reason, I don't think industry cares to.

I don't know, I think we may come up -- and I was talking here whether we needed an executive session. I think the consensus is we probably don't. We can come up with a conclusion on this. I think we can repeat, incorporate at least the factual findings of the first session of the conference in here: that this is an interstate water; that there is pollution occurring subject to abatement under the Federal act, and that a major source of this pollution is discharges from the Olin Mathieson plant at Saltville. I think we can also indicate that cognizance is taken of the fact that the state water pollution control agencies, of Virginia particularly, which has initial responsibility, and Tennessee have looked into this problem, and the agencies have worked diligently toward finding a solution.

In the opinion of these agencies -- check me on this -- I don't know that the Tennessee agency has considered this formally, because you are in Virginia and Virginia has the primary responsibility -- in the examination of the problem, the Virginia agency believes that we are going to have the problem under existing techniques; we can alleviate it somewhat, but we are going to have the problem, in the absence of taking the drastic action of shutting the mill down, which no one seems to want to do.

Cognizance is also taken of the fact that the Olin Mathieson plant will spend a million dollars to attempt to alleviate the situation. This will remove -- hopefully remove the peaks from the chloride discharges. This will not alleviate it completely.

I would like to throw this out, and if there is any other discussion on this, I think we might look forward to the possibility of Olin Mathieson receiving from a cooperative Federal-state program data indicating when these discharges would cause the least damage. As Mr. Logan indicated, sitting up at Saltville and letting that stream flow by, they can just make pretty good guesses, but I think possibly the technique of stream flows and discharges is much more refined than that now. What it would take would be a network and some kind of system whereby we can feed this material into a computer. That can be made available.

I think also that consideration might be given to a joint Federal-state monitoring of the stream, joint state-Federal monitoring of the stream, and I think we have a pretty good before picture, after this impoundment goes into effect. It it is necessary to get the before picture and do more work, all right, but I think this is a fairly consistent picture, after the impoundment goes into effect.

Also I would think that we would ask the Olin Mathieson Company -- I don't know when this can be done, at first, and we would have to ask the state, as a matter of fact -- we would have to work up a report to see what progress we were making toward a definitive solution of the problem. I think, as I pointed out, this conference is between us and the states. We will get in touch with the states and hopefully the states will have this information. I think, however, to be objective and to be fair, I think we would have to point out, as Mr. Walker said, that while these peaks would be reduced, chlorides are going in and the pollution problem will continue to exist. And I think this, as far as I am concerned, from the Federal Government, it extends to the extent of my authority; and further action, if any, would have to be taken by the Secretary.

Now I do think one point. We do have the authority, if you deem it appropriate, and I don't see this necessarily now, unless we have something else to discuss, on the assumption that the Secretary will not take further action in calling a hearing, we can, if the parties deem it appropriate, reconvene this conference again, or have a meeting, if that is what you people desire. We can leave it that way.

I do not think from where we sit here, unless Mr. Thoman has a different view, that the initiative for having another conference will necessarily come from the Federal Government, unless there is something startling new. However, if the states wish to have another conference, another session, or as far as the meeting is concerned, if the states or the industry wish to have, that will be available.

DR. HUTCHESON: Mr. Stein, I have two things I want to say. First, in calling those in Tennessee, Mr. Jones tells me he inadvertently overlooked Mr. M. A. Churchill, TVA, and I would like him, if he wishes to put anything in the record that he might want to say.

MR. MILO CHURCHILL: I think I did make my statement.

MR. JONES: I am sorry.

DR. HUTCHESON: This, then, I would like to say. I would like to suggest that we recess this hearing, rather than adjourning it, with the understanding that the technical staffs of the two state Stream Pollution Control Boards and the TVA continue to work cooperatively on this program in an effort to see if there can be any improvement in the situation in the North Fork of the Holston River and the river south of us.

CHAIRMAN STEIN: I understand what you say. I am not asking the shock question, but just for clarification, you say the two states and TVA.

DR. HUTCHESON: No, two states and Olin Mathieson. I didn't mean TVA. Excuse me.

CHAIRMAN STEIN: Your proposal is not to have a Federal representative on that technical group?

DR. HUTCHESON: Sure, I am glad to have it.

CHAIRMAN STEIN: Well, this is all I want to know.

DR. HUTCHESON: We want any help we can get.

CHAIRMAN STEIN: This is what I want to understand.

DR. HUTCHESON: Say the two states, Olin Mathieson and the representation from the technical staff of the Federal Public Health Service.

CHAIRMAN STEIN: And we can have TVA.

DR. HUTCHESON: TVA, we count them as part of our state. (Laughter)

MR. WALKER: It seems to me that all of this discussion of the peaks of the flow, you in Tennessee are concerned with those variations below the dam. We can't be concerned with that because it isn't a problem that we have any control over whatever. We can be concerned about the peaks coming into Tennessee. I think your problem there, as I see it, is one very largely in control of this discharge from the dam.

DR. HUTCHESON: You have some control over the mechanics and logistics of the releases.

MR. WALKER: Where, below the dam?

DR. HUTCHESON: No, up there at Olin Mathieson.

MR. WALKER: I say we are concerned with it until it gets to Tennessee. But from what Mr. Jones said, I take it a lot of your problem here with your fluctuations is the discharge from the dam. In other words, if it was coming on an even basis down to you, you would still have your variations below. Maybe I am mistaken about that. Is that true, Mr. Jones?

MR. JONES: That is true. That is part of it.

DR. HUTCHESON: That is part of it, not all of it.

MR. WALKER: I think that is your problem with the TVA on that phase.

CHAIRMAN STEIN: I think, and see if I am correct on this assumption, if the people in Tennessee knew what they were getting, they might be able to adjust their flow.

I think in this way the Technical Committee can work. Are we agreed to put this in recess and put that Technical Committee to work? Does anyone else want to say anything in the audience or have any comment on where we go from here?

I might point out here, if no one has anything to say, that we have had these pollution problems, severe pollution problems, throughout the country involving well over 250 cities and 250 industries and more than half a billion dollars in construction. I don't think that anywhere we have had one which has been more difficult of reasonable solution than the one at Saltville. I think the Virginia agency should be commended for working with this for years. This is something, I think, we just have to put in perspective. We have a problem on this river, on the North Fork of the Holston right down here, which presents problems, more difficult problems than I in my 21 years of experience in the business have ever run into. I think we will just have to work our way through this and try to find a solution.

Now in many, many other cases the situation looked impossible, and yet I think we have come up with reasonable solutions. This one hasn't broken. This is the way these things look. I think we can all remember, at least some of us here from Virginia, the Potomac problem, which didn't look too good years ago, and I think that is on the way. That is in the Washington metropolitan area. We are on our way to a solution of that problem now.

We are still at the stage here where we have a most difficult case.

Any comments or questions? If not --

MRS. THOMAS W. FINUCANE: I am Mrs. Finucane, the League of Women Voters. Mr. Churchill said that if all the material were put together, it would be twice as much as the State of Tennessee could stand, that is after Mr. Logan's company spends all this money and so on and gets things down on an average, it will be double the allowable material still?

CHAIRMAN STEIN: No. I think we will let Mr. Churchill -- do you want to come up and explain that again, Mr. Churchill?

I didn't think he said what it could stand, because they are standing a lot more now.

I want to say something for the League of Women Voters. I don't want to be against the scientists or the other laymen in here. This material you see about averages is very, very fine. Now the question to a layman that hits you are the peaks you get. For example, if you have a bathing beach and say you have an average of say a thousand colioform bacteria, which may not be too good or too bad during the month of August, this may be a tolerable condition, but in 10 days out of that month if your colioform bacteria went up to say 10,000 or one day 100,000 and then some days are very low, this average doesn't mean very much if your children are out swimming during those 10 days when they are really high.

The question here is we have to understand if there are significant pollutants in the water during significant times of the year to interfere with water uses.

Mr. Churchill, did you hear the question?

MR. CHURCHILL: I will try again to explain. It is a little tricky. The whole idea is to attempt to understand what concentrations, what mean concentrations could be reached, if all the waters in both the North and the South Fork were used to the best possible advantage to hold mean concentrations at the lowest possible levels. Under that condition, that could be done. Concentrations of chlorides and hardness would still be a hundred per cent above what the State of Tennessee expressed a desire to obtain at a hearing held in Richmond in 1956. Is that clear?

MRS. FINUCANE: In other words, if Mr. Logan builds his dam and if it works perfectly, it will still be a hundred per cent too high?

CHAIRMAN STEIN: No, no.

MR. CHURCHILL: It will be a lot more than that.

CHAIRMAN STEIN: I am talking about the water in the South Fork as well as the North Fork and not just above Saltville, all the way down to the mouth of the North Fork, which is a much bigger area than just the area above Saltville. Mr. Logan's project will obviously help in ironing out fluctuations, but it will certainly not meet the objectives expressed in 1956 by the State of Tennessee in Richmond, Virginia.

I wonder if this can explain it. At times now they may -- if I am wrong on this figure, hold me back -- they may be getting chlorides in the Holston down in Tennessee about 450 p.p.m. Now maybe they want to get down to desirable loading to a hundred for use. In fact now, they are getting this down there. They are going up as high as 450. Now if Mr. Logan builds his dam and you had optimum conditions, you presumably could get down to 200, which is still a lot better than 450, but not what Mr. Jones or Dr. Hutcheson would desire, and they feel that this is an objective.

I think what we are getting at is this. While Mr. Logan's dam, if it works to its optimum, will not quite come down to the objective desired by Tennessee, it would still create conditions better than you have today. It will improve the situation. This is the point.

Are there any further questions or problems? If not, thank you all for coming, and we stand adjourned.

. . . The meeting adjourned at 12:30 o'clock, p. m. . . .